



**Source Emissions Testing Report
BD Medical**

**Ethylene Oxide Sterilization Chamber
Catalytic Oxidizer
Columbus, Nebraska**

Report prepared for:
BD Medical
920 East 19th Street
Columbus, Nebraska 68601

Report prepared by:
Air Pollution Testing, Inc.
5530 Marshall Street
Arvada, Colorado 80002

Test Date:
July 11, 2017

APT Project: BDM7096

DENVER OFFICE
5530 Marshall Street
Arvada, CO 80002
(303) 420-5949
FAX (303) 420-5920
(800) 268-6213



Certification

Team Leader Certification:

I certify that all of the sampling and analytical procedures and data presented in this report are authentic and accurate.

A handwritten signature in black ink, appearing to read "Ken Moody".

Ken Moody
Field Team Leader / Project Manager

Reviewer Certification:

I certify that all of the testing details and conclusions are accurate and valid.

A handwritten signature in black ink, appearing to read "Connor Abendschein".

Connor Abendschein
Reviewer / Technical Writer



Table of Contents

1. Introduction.....	1
2. Test Results Summary.....	2
3. Methods.....	3
4. Test Program Summary.....	4
5. Test Method Details.....	5
6. Conclusions.....	6

Tables

Table 1.1: Testing Personnel Contact Personnel.....	1
Table 1.2: Source Identification Summary.....	2
Table 2.1: Ethylene Oxide Catalytic Oxidizer Test Results.....	3
Table 4.1: Sampling and Analytical Methods Summary.....	4

Appendices

Testing Parameters / Sample Calculations.....	Appendix 1
Field Data.....	Appendix 2
Calibration Information.....	Appendix 3
Schematics.....	Appendix 4
Operating Data.....	Appendix 5

1. Introduction

Air Pollution Testing, Inc (APT) was contracted by Becton-Dickinson Medical (BD Medical) for emission testing services at the BD Medical facility located in Columbus, Nebraska.

The purpose of the emissions testing program was to quantify the concentrations and mass flow rates of ethylene oxide into and out of the ethylene oxide sterilization chamber to determine the ethylene oxide destruction removal efficiency (DRE).

The testing was conducted to satisfy applicable requirements imposed by the United States Environmental Protection Agency (EPA) and the Nebraska Department of Environmental Quality (NDEQ). The facility is subject to the emission limits and testing requirements provided in *40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart O – Ethylene Oxide Emissions Standards for Sterilization Facilities*. The unit is required to demonstrate 99% DRE.

Table 1.1 provides key project personnel, company affiliations and contact information. Source identification and operating standards are summarized in Table 1.2.

BD Medical – Columbus, Nebraska Ethylene Oxide Catalytic Oxidizer Testing Program Contact Personnel		
<i>Name, Title</i>	<i>Company Address</i>	<i>Phone, Fax, Email</i>
Ms. Sharon Huey, Environmental/Safety Engineer	BD Medical 920 East 19 th Street Columbus, Nebraska 68601	402-835-1409, sharon_huey@bd.com
Mr. Brad Pracheil, Compliance Specialist	NDEQ 1200 "N" Street, Suite 400 P.O. Box 98922 Lincoln, Nebraska 68509-8922	402-471-4141, brad.pracheil@nebraska.gov
Mr. David Maiers, Director of Operations	Air Pollution Testing, Inc. 5530 Marshall Street Arvada, Colorado 80002	303-420-5949 x 33, dmaiers@airtest.net

Table 1.1: Testing Program Contact Personnel

BD Medical – Columbus, Nebraska Ethylene Oxide Catalytic Oxidizer Source Identification Summary	
<i>Source Identification</i>	<i>Standards and Operating Limits</i>
Catalytic Oxidizer	Ethylene Oxide DRE \geq 99% Catalyst bed outlet temperature to be recorded

Table 1.2: Source Identification Summary

2. Test Results Summary

The results of the testing program are summarized in Table 2.1 on the following page. Any emission parameters not presented in the table may be found in *Appendix 1*. The following terms are used in the table:

- temp °F – degrees Fahrenheit
- %vd – diluent concentration, dry volume percent
- %vw – stack gas moisture content, wet volume percent
- dscfm – stack gas flow rate, dry standard (one atm., 68 °F) cubic feet per minute
- lb/hr – pollutant mass emission rate, pounds per hour
- ppmvd – pollutant concentration, parts per million dry volume basis
- DRE – destruction removal efficiency
- C₂H₄O – ethylene oxide

Test Report – BD Medical
Columbus, Nebraska – Ethylene Oxide DRE
APT Project BDM7096

BD Medical – Columbus, Nebraska Ethylene Oxide Catalytic Oxidizer: Test Results (July 12, 2017)					
	Run #1	Run #2	Run #3	Average	Permit Limits
Start Time	11:30	12:40	13:45		
Stop Time	12:30	13:40	14:45		
O ₂ (%vd)	20.9	20.9	20.9	20.9	
CO ₂ (%vd)	0.0	0.0	0.0	0.0	
Stack Temp (°F)	179	181	190	184	
Catalyst Temperature (°F)	231	244	235	237	
H ₂ O (%vw)	3.9	3.1	3.0	3.3	
Gas Flow (dscfm)	4,591	4,635	4,477	4,568	
Emissions Data					
C ₂ H ₄ O (ppmvd)	0.76	0.38	0.28	0.48	
C ₂ H ₄ O (lb/hr)	0.024	0.012	0.009	0.015	
Inlet C ₂ H ₄ O (ppmvd)	1,357.4	1,451.2	1,214.5	1,341.0	
Inlet C ₂ H ₄ O (lb/hr)	41.59	44.12	37.35	41.02	
Control Efficiency					
C ₂ H ₄ O (ppmvd)	99.94	99.97	99.98	99.96	99%
DRE					
C ₂ H ₄ O (lb/hr)	99.94	99.97	99.98	99.96	
The data presented are outlet numbers except where noted.					

Table 2.1: Ethylene Oxide Catalytic Oxidizer Test Results

3. Methods

3.1. Test Methods

APT tested in accordance with the following U.S. Environmental Protection Agency (EPA) source emission test methods referenced in 40 CFR Part 60, Appendix A.

- *Method 1 – Sample and Velocity Traverses for Stationary Sources*
- *Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate*
- *Method 3 – Gas Analysis for the Determination of Dry Molecular Weight*
- *Method 4 – Determination of Moisture Content in Stack Gases*
- *Method 18 – Measurement of Gaseous Organic Compound Emissions by Gas Chromatography*

3.2. Method Deviations

At the inlet sampling location, APT did not conduct EPA Method 4 sampling for moisture determination. Moisture determination at the inlet sampling location poses significant ethylene oxide exposure risks. Previous testing at this facility and on identical ethylene oxide sterilization chambers indicate moisture values to be close to ambient conditions for both the inlet and outlet sampling locations. Moisture content was determined from the outlet sampling location only and used for both the inlet and outlet volumetric flow calculations.

4. Test Program Summary

The test program determined all of the parameters detailed in Table 4.1.

Three (3), 1-hour test runs were conducted to determine the emission concentrations of ethylene oxide into and out of the sterilization chamber. Concurrent volumetric flow measurements were conducted at the outlet to allow for the calculation of mass emissions. Since the stack gas content is essentially air, a dry molecular weight of 29.0 was assumed. DRE was determined by comparing the inlet and outlet ethylene oxide values on a mass flow basis.

Previous testing at this facility indicated lower than expected inlet ethylene oxide levels, necessitating very low detection limits at the outlet to demonstrate 99% control. The test used direct-interface EPA Method 18 on-site gas chromatographs equipped with flame ionization detectors (GCFID) to determine the inlet and outlet levels of ethylene oxide. The GCFID was calibrated with ethylene oxide balanced nitrogen standards certified to 2% accuracy or dilutions of certified standards.

During the test program, the catalyst bed outlet temperature was monitored by BD Medical personnel and can be found in *Appendix 5*.

BD Medical – Columbus, Nebraska Ethylene Oxide Catalytic Oxidizer Testing Program Sampling and Analytical Methods Summary			
Parameter	Sampling Method	Analytical Method	Laboratory
gas flow rate	Methods 1 and 2	thermocouple, pitot tube and draft gauge	APT, on-site
O ₂ , CO ₂	Method 3	wet chemical (Fyrite)	
H ₂ O	Method 4	gravimetric	
Ethylene oxide	Method 18	gas chromatograph with flame ionization detector	

Table 4.1: Sampling and Analytical Methods Summary

5. Test Method Details

5.1. Stack Gas Flow, Diluent, and Moisture Content

Stack gas velocity, volumetric flow rate, diluent (O_2 and CO_2), and moisture (H_2O) content were measured in accordance with EPA Methods 1, 2, 3 and 4.

Each sampling period consisted of conducting a temperature and differential pressure traverse of each sampling location using a K-type thermocouple and an S-type pitot tube. Concurrent with each traverse, a sample of gas for moisture determination was extracted from the stack at a constant flow rate of no more than 0.75 cubic feet per minute (cfm). The gas sample passed through a stainless steel probe, through a series of four (4) chilled glass impingers, and through a calibrated dry gas meter. Please see *Appendix 4 – Schematics* for a drawing of the EPA Methods 1, 2 and 4 sampling train.

Prior to sampling, the first two impingers were each seeded with 100 milliliters of water. The third impinger was empty. The fourth impinger was seeded with 250 grams of dried silica gel. Following sampling, the moisture gain in the impingers was measured gravimetrically to determine the moisture content of the stack gas.

Concurrent with each velocity traverse, a sample of stack gas was collected in a Tedlar bag for on-site analysis with a Fyrite instrument to determine O_2 and CO_2 concentrations. Since the stack gas content is essentially air, a dry molecular weight of 29.0 was assumed.

All of the above data were combined to calculate the stack gas velocity and volumetric flow rate in units of feet per second (ft/sec), actual cubic feet per minute (acf m), dry standard cubic feet per minute (dscfm), and pounds per hour (lb/hr).

5.2. Ethylene Oxide

Ethylene oxide levels were determined in accordance with EPA Method 18 using the direct interface sampling and analysis procedures detailed in the method. Samples were analyzed on-site with two HP Model 5890 Series II Gas Chromatographs (GC) equipped with a flame ionization detector (FID) and Chemstation software.

Using a heated sample probe/line, stack gas was transported directly to the gas sampling valve of each GC. Samples were analyzed approximately once each 10 minutes. A “test run” consisted of five (5) consecutive injections. Three test runs were conducted (for a total of 15 injections) at the inlet and outlet of the catalytic oxidizer.

Prior to sampling, gas phase calibration standards were prepared by dilution of a +/-2% accuracy certified gas standard. Preparation of diluted standards was conducted using a gas-tight volumetric syringe and new Tedlar bags. Triplicate (minimum, more if required to meet the 5% agreement limit) injections were conducted for each standard, and a calibration curve of peak area versus concentration was prepared. A least squares line

Test Report – BD Medical
Columbus, Nebraska – Ethylene Oxide DRE
APT Project BDM7096

(y=mx) was fit to each data set. A line loss test was conducted to ensure adequate sampling system performance.

Following analysis of stack gas samples, the mid-level calibration standard was re-analyzed at the gas sampling valve in triplicate. Because the average of the initial calibration response (triplicate average) and the post-test check response (triplicate average) were within 5% of their mean value, the initial calibration linear regression data were used to quantify the emission levels for each GC.

The results of the GC analysis were used to calculate ethylene oxide levels in units of parts per million, wet volume basis (ppmw). The data were combined with stack gas volumetric flow rate data to calculate emissions in units of pounds per hour (lb/hr). Catalytic oxidizer DRE was calculated on a mass basis.

6. Conclusions

The testing conducted by APT on the ethylene oxide catalytic oxidizer at the BD Medical facility in Columbus, Nebraska on July 12, 2017 demonstrates that the unit is operating in compliance with the emission limits imposed by the EPA and the NDEQ.



Appendix One: Testing Parameters / Sample Calculations

BD Medical
Columbus, Nebraska
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

Field Reference Method Data (Inlet)					
	Run #	1	2	3	Average
	Start Time	11:30	12:40	13:45	
	Stop Time	12:30	13:40	14:45	
	Sample Time	60	60	60	
hrs	Hours of Operation / Year	8,760	8,760	8,760	8,760
D _s	Stack Diameter (inches)	23.25	23.25	23.25	23.25
ΔP _{AVG}	(Delta P) ^{1/2}	0.495	0.491	0.496	0.494
C _p	Pitot Tube Constant (unitless)	0.821	0.821	0.821	0.821
T _s	Stack Temp (°F)	76.2	78.1	78.0	77.4
P _{bar}	Barometric Press (mbar)	960	960	960	960.0
P _{bar}	Barometric Press ("Hg)	28.35	28.35	28.35	28
P _s	Stack Pressure ("H ₂ O)	-8.10	-8.10	-8.10	-8.1
Y _d	Meter Y Factor (unitless)	0.996	0.996	0.996	1
T _m	Meter Temperature (°F)	98	94	94	94.9
V _m	Sample Volume (ft ³)	37.600	37.946	37.277	38
ΔH	Delta H ("H ₂ O)	1.0	1.0	1.0	1.0
V _{lc}	Moisture (grams)	29.0	23.1	21.8	25
O _{2%vd}	O ₂ (%vd)	20.9	20.9	20.9	20.9
CO _{2%vd}	CO ₂ (%vd)	0.0	0.0	0.0	0
N _{2%vd}	N ₂ (%vd)	79.1	79.1	79.1	79.1

Field Reference Method Data (Outlet)				
	1	2	3	Average
	11:30	12:40	13:45	
	12:30	13:40	14:45	
	60	60	60	
	8,760	8,760	8,760	8,760
	23.50	23.50	23.50	23.50
	0.540	0.543	0.527	0.537
	0.821	0.821	0.821	0.821
	179.3	181.4	190.1	183.6
	960	960	960	960.0
	28.35	28.35	28.35	28.35
	-0.21	-0.21	-0.21	-0.21
	0.996	0.996	0.996	0.996
	98	94	94	94.9
	37.600	37.946	37.277	37.608
	1.0	1.0	1.0	1.0
	29.0	23.1	21.8	24.6
	20.9	20.9	20.9	20.9
	0.0	0.0	0.0	0
	79.1	79.1	79.1	79.1

Method 18 GC Data (Inlet)					
MW	Run #	1	2	3	Average
44.05	Ethylene Oxide (ppmvw)	1312.82	1406.50	1174.62	1297.98

Method 18 GC Data (Outlet)				
	1	2	3	Average
	0.73	0.37	0.28	0.46

Reference Method Calculations (Inlet)					
	Run #	1	2	3	Average
V _{mstd}	Sample Volume (dscf)	33.679	34.222	33.631	33.844
V _{wstd}	Moisture Volume (scf)	1.37	1.09	1.03	1.16
B _{ws}	Moisture Content (%/100)	0.033	0.031	0.030	0.031
M _D	Molecular Weight Dry	28.84	28.84	28.84	28.84
M _A	Molecular Weight Wet	28.48	28.50	28.52	28.499
V _s	Gas Velocity (ft/sec)	28.6	28.4	28.7	28.58
F _{ACFM}	Gas Flow (acfmin)	5,060	5,028	5,079	5055.564
F _{DSCFM}	Gas Flow (dscfm)	4,470	4,435	4,486	4463.98
lb/hr	Gas Flow (lb/hr)	20,497	20,311	20,529	20446.013
	Ethylene Oxide (ppmvd)	1,357.4	1,451.2	1,214.5	1,341.0
	Ethylene Oxide (lb/hr)	41.59	44.12	37.35	41.02
	Ethylene Oxide (tpy)	182.2	193.2	163.6	179.65

Reference Method Calculations (Outlet)				
	1	2	3	Average
	33.679	34.222	33.631	33.844
	1.37	1.09	1.03	1.16
	0.039	0.031	0.030	0.033
	28.84	28.84	28.84	28.84
	28.41	28.50	28.52	28.477
	33.8	33.9	33.2	33.65
	6,108	6,135	5,999	6,080.6
	4,591	4,635	4,477	4,567.8
	21,138	21,226	20,486	20,950.2
	0.76	0.38	0.28	0.48
	0.024	0.012	0.009	0.015
	0.10	0.05	0.04	0.07

DRE Calculations					
	Run #	1	2	3	Average
dry	Inlet C ₂ H ₄ O (ppmvd)	1,357.4	1,451.2	1,214.5	1,341.0
lb/hr	Inlet C ₂ H ₄ O (lb/hr)	41.6	44.1	37.3	41.0
dry	Outlet C ₂ H ₄ O (ppmvd)	0.8	0.4	0.3	0.5
lb/hr	Outlet C ₂ H ₄ O (lb/hr)	0.02	0.01	0.01	0.0
Eff %	Control Eff % C ₂ H ₄ O (ppmvd)	99.94%	99.97%	99.98%	99.96%
DRE	%DRE C ₂ H ₄ O (lb/hr)	99.94%	99.97%	99.98%	99.964%

Lb/hr Limit is 99%

BD Medical
Catalytic Oxidizer DRE Inlet / Outlet
 07/11/17
EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Sample Analysis (Inlet)													
Run 1													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.697	1767152.5	1.698	2789398	1.699	2016403	1.699	2497750	1.7	2973570	1.699	2408855	1312.82

Run 2													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.701	3776665.3	1.703	2481448	1.703	2372176	1.705	2182679	1.706	2090721	1.704	2580738	1406.50

Run 3													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.706	2569191.8	1.707	1586118	1.707	2428758	1.708	1540889	1.71	2651382	1.708	2155268	1174.62

Sample Analysis (Outlet)													
Run 1													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.329	1196.2	1.33	1455.2	1.332	1092	1.333	1118.0	1.33	4651.7	1.331	1903	0.73

Run 2													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.399	859.5	1.334	849.1	1.33	1104.6	1.374	930.4	1.327	1121.3	1.353	973	0.37

Run 3													
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5	Average			
ID	RT	AC	RT	AC	RT	AC	RT	AC	RT	AC			
Ethylene Oxide	1.380	713.1	1.335	837.6	1.330	0	1.333	953.9	1.329	1101.6	1.341	721	0.28

BD Medical
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Initial Three-Point Calibration (Inlet) High Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT AC	OK?
Ethylene Oxide	5222.00	1.724	9724545.0	1.72	9715351.0	1.718	9766537.0	1.721	9735478 Y

Six-Point
Pre/Post
Average
AC

Pre/Post
Average
AC

Pre/Post
Average
AC

Mid-Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT AC	OK?
Ethylene Oxide	2611.00	1.717	4557966.5	1.717	4551561.0	1.717	4617239.0	1.717	4575589 Y

Pre/Post
Average
AC

Low-Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.20015 AC	Inj. 2 RT	Sig.20016 AC	Inj. 3 RT	Sig.20017 AC	Average RT AC	OK?
Ethylene Oxide	1305.50	1.717	2172597.2	1.717	2152945.2	1.717	2148206.7	1.717	2157916 Y

Pre/Post
Average
AC

Initial Three-Point Calibration (Outlet) Low Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT AC	OK?
Ethylene Oxide	50.02	1.319	129071.5	1.318	127810.1	1.317	126555.1	1.318	127812 Y

Six-Point
Pre/Post
Average
AC

Mid-Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT AC	OK?
Ethylene Oxide	25.01	1.317	67103.7	1.318	65834.6	1.318	64985.5	1.318	65975 Y

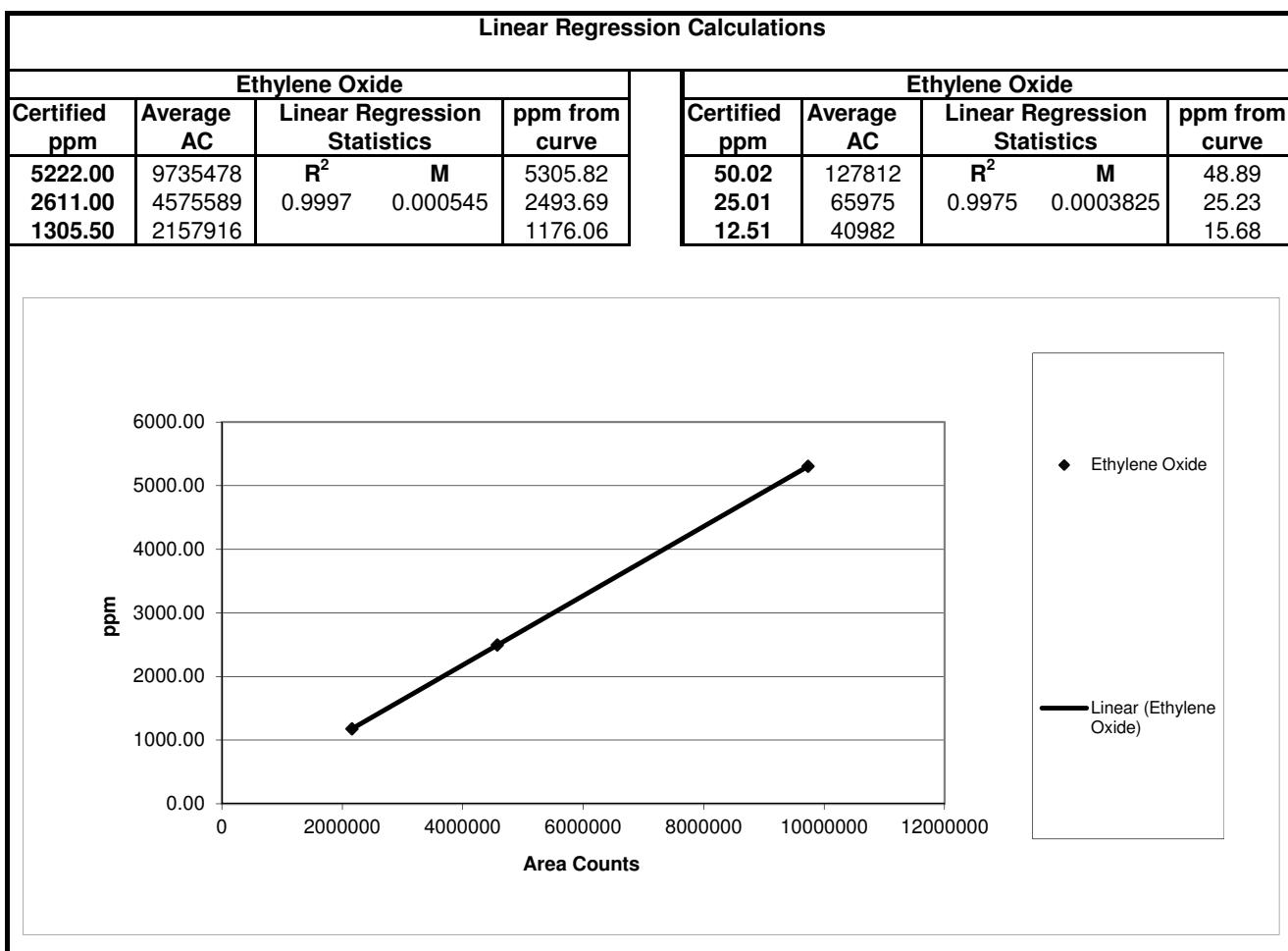
Pre/Post
Average
AC

Low-Level Calibration Standard									
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT AC	OK?
Ethylene Oxide	12.51	1.317	42294.8	1.318	41215	1.319	39436.5	1.318	40982 Y

Pre/Post
Average
AC

BD Medical
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography



BD Medical
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017
EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Quality Assurance Inlet												
Inlet Line Loss Check (mid-level calibration gas to the sample probe)												
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.20018 AC	Inj. 2 RT	Sig.20019 AC	Inj. 3 RT	Sig.20020 AC	Average RT	AC	ppm	TriPLICATE OK?	RECOVERY OK?
Ethylene Oxide	5222.00	1.724	9921797	1.725	9865518	1.727	10055876	1.725	9947730	5421.50	Y	Y

Inlet Post Test Calibration Check (mid-level calibration gas to the gas sampling valve)												
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT	AC	ppm	TriPLICATE OK?	PRE/POST OK?
Ethylene Oxide	2611.00	1.712	4937903.5	1.712	4795114.0	1.712	4855798.5	1.712	4862939	2650.30	Y	Y

BD Medical

Catalytic Oxidizer DRE Inlet / Outlet

7/11/2017

EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Quality Assurance Outlet											
Outlet Line Loss Check (mid-level calibration gas to the sample probe)											
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.10018 AC	Inj. 2 RT	Sig.10019 AC	Inj. 3 RT	Sig.10020 AC	Average RT	AC	ppm	TriPLICATE OK? Recovery OK?
Ethylene Oxide	50.02	1.325	128444.8	1.328	136299.3	1.329	123683.3	1.327	129476	49.52	Y Y

Outlet Post Test Calibration Check (mid-level calibration gas to the gas sampling valve)											
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.10043 AC	Inj. 2 RT	Sig.10044 AC	Inj. 3 RT	Sig.10045 AC	Average RT	AC	ppm	TriPLICATE OK? Pre/Post OK?
Ethylene Oxide	25.01	1.325	65679.3	1.324	63363.3	1.325	65087.9	1.325	64710	24.75	Y Y

Sample Calculations

BD Medical
Columbus, Nebraska
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Sample Calculations

$$\text{sample volume (scf)} = \frac{17.64 * V_M * Y_D * \{P_B + \Delta H/13.6\}}{T_M + 460}$$

$$= \frac{17.64 * 37.608 * 0.996 * \{ 28.35 + 1.0 / 13.6 \}}{95 + 460}$$

$$= 33.844$$

$$\text{moisture volume (scf)} = 0.04715 * V_{LC}$$

$$= 0.04715 * 24.63$$

$$= 1.16$$

$$\text{moisture content (\% / 100)} = \frac{V_{W(STD)}}{(V_{M(STD)} + V_{W(STD)})}$$

$$= \frac{1.161}{(33.844 + 1.161)}$$

$$= 0.033$$

$$\text{molecular weight, dry (grams/mol)} = (0.440) * (\%CO_2) + (0.320) * (\%O_2) + (0.280) * (\%N_2 + \%CO)$$

$$= (0.440) * 7.5 + (0.320) * 8.8 + (0.280) * (83.7 + 0.0)$$

$$= 29.56$$

$$\text{molecular weight, actual (grams/mol)} = M_D * (1 - B_{WS}) + (18.0) * B_{WS}$$

$$= 29.56 * (1 - 0.033) + (18 * 0.033)$$

$$= 29.17$$

BD Medical
Columbus, Nebraska
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Sample Calculations (continued)

$$\begin{aligned}
 \text{gas velocity (ft/sec)} &= 85.49 * C_P * \sqrt{\Delta P_{AVG} * \frac{T_S + 460}{[P_B + P_S / 13.6] * M_A}} \\
 &= (85.49) * 0.821 * 0.536767 * \sqrt{\left[\frac{184 + 460}{28.35 + \frac{-0.21}{13.6}} \right] * 29.17} \\
 &= 33.2 \\
 \text{gas flow (acfpm)} &= 60 * \frac{\pi * (D_S / 12)^2}{4} * V_S \\
 &= 60 * \frac{\pi * (23.5 / 12)^2}{4} * 33.2 \\
 &= 6,008 \\
 \text{gas flow (dscfm)} &= 60 * V_S * (1 - B_{WS}) * \frac{\pi * (D_S / 12)^2}{4} * \frac{T_{STD} * [P_B + P_S / 13.6]}{(T_S + 460) * P_{STD}} \\
 &= 60 * 33.2 * (1 - 0.033) * \frac{\pi * (23.5 / 12)^2}{4} * \frac{528 * [28.35 + -0.21 / 13.6]}{(184 + 460) * 29.92} \\
 &= 4,512
 \end{aligned}$$

BD Medical
Columbus, Nebraska
Catalytic Oxidizer DRE Inlet / Outlet
7/11/2017

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Variables and Abbreviations

B_{WS} - moisture content of the gas (wet volume percent/100)

%CO - carbon monoxide content of the gas (dry volume percent)

%CO₂ - carbon dioxide content of the gas (dry volume percent)

C_P - pitot tube constant (unitless)

D_S - diameter of the stack (inches)

ΔH - pressure differential at dry gas meter exit orifice (inches water)

M_D - molecular weight of the dry gas (grams per mol)

M_A - molecular weight of the wet gas (grams per mol)

%N₂ - nitrogen content of the gas (dry volume percent)

%O₂ - oxygen content of the gas (dry volume percent)

P_{Avg} - average square root of the stack gas pitot differential pressure (inches water)

P_B - barometric pressure (inches mercury)

P_S - stack pressure relative to barometric pressure (inches water)

P_{STD} - standard pressure (29.92 inches mercury)

T_M - average dry gas meter temperature (°F)

T_S - average stack temperature (°F)

T_{STD} - standard temperature (528 °R)

V_{LC} - volume of moisture collected as a liquid (milliliters)

V_M - volume indicated on dry gas meter (uncorrected actual cubic feet)

V_{MSTD} - volume of gas through dry gas meter (corrected dry standard cubic feet)

V_S - stack gas velocity (feet per second)

V_{WSTD} - volume of moisture collected as a gas at standard conditions (standard cubic feet)

Y_D - dry gas meter calibration factor (unitless)

BD Medical
Columbus, Nebraska
Catalytic Oxidizer DRE Inlet / Outlet
07/11/17

EPA Method 18: Measurement of Gaseous Organic Compounds by Gas Chromatography

Sample Calculations

$$\begin{aligned} \text{EO conc (ppmvd as C}_3\text{H}_8\text{)} &= \frac{[\text{EO conc (ppmvw)}]}{(1 - B_{ws})} \\ &= \frac{0.5}{(1 - 0.014)} \\ &= 0.48 \end{aligned}$$

$$\begin{aligned} \text{EO emissions (lb/hr)} &= [\text{EO (ppmvd)}] * (F_{DSCFM}) * (1.556 \times 10 E-7) * (44.05) \\ &= (0.48) * (4,568) * (1.556 \times 10 E-7) * 44.05 \\ &= 0.015 \\ \text{EO emissions (tons/year)} &= \frac{[\text{EO emissions (lb/hr)}] * [8,760 (\text{hours/year})]}{[2,000 (\text{pounds/ton})]} \\ &= (0.015) * \frac{(8760)}{(2000)} \\ &= 0.07 \end{aligned}$$

Variables and Abbreviations

EO - ethylen oxide

B_{ws} - moisture content of the gas (wet volume percent/100)

cal - calibrated

conc - concentration

F_{DSCFM} - gas flow (dry standard cubic feet per minute, where standard = 29.92 inches Hg and 68°F)

lb/hr - pounds per hour

tpy - tons per year

ppmvw - parts per million, wet volume basis



Appendix Two: Field Data

Air Pollution Testing Inc. : EPA Method 2 - Verification of Absence of Cyclonic Flow Datasheet

Job #: BDM17096
 Facility: BD Medical
 Date: 7/12/17
 Probe ID: P-497
 Pitot Constant: 0.805 .821.05

Operator: Kerr, Leonard
 Site: CATALYTIC OXIDIZER
 Points:

1	<u>4.8</u>	<u>25.0</u>
2	<u>6.5</u>	<u>26.7</u>
3	<u>8.6</u>	<u>9</u>
4	<u>11.6</u>	<u>10</u>
5	<u>19.9</u>	<u>11</u>
6	<u>22.9</u>	<u>12</u>

Post Test Pitot Leak Check Good?: 0.00 CS-H20

Point #	Delta P at 0 degrees	Angle at 0.0 Delta P	Point #	Delta P at 0 degrees	Angle at 0.0 Delta P	Point #	Delta P at 0 degrees	Angle at 0.0 Delta P	Point #	Delta P at 0 degrees	Angle at 0.0 Delta P
1-1	.02	8									
2	.02	6									
3	.04	4									
4	.02	7									
5	.03	6									
6	.05	9									
7	.02	4									
8	.01	3									
1-1	.02	9									
2	.03	7									
3	.03	4									
4	.03	5									
5	.02	7									
6	.01	7									
7	.02	6									
8	.03	7									

Average Absolute Angle = < 20°

Average Absolute Angle =

Average Absolute Angle =

* If the absolute average angle is greater than 20 degrees, the flow is considered non-laminar and an alternative method must be used.

Outlet Runs - 1-3

Air Pollution Testing Inc.: EPA Method 2 - Pitot Traverse Datasheet									
Job #:	BDM7046		Operator:	TGA-TK		Stack Diameter (Inches):	33.5		
Facility:	BP Midwest		Site:	Catalytic Oxidizer	Points:	1 11.8	5 19.4	9	Upstream Disturbance (Inches): ~30
Date:	7-13-17		Probe ID:	2-4517	2 6.5	6 22.9	10	Downstream Disturbance (Inches): ~20	
Pitot Constant:	0.806 - .8210			3 8.6	7 25.0	11	Schematic of Sampling Location:		
Run #:	1		Run #:	2		Run #:	3		
O2%:	21	CO2%:	0	O2%:	21	CO2%:	0	O2%:	21
H2O%:	0.015	H2O%:	0.012	H2O%:	0.012	measured / estimate	0.015	H2O%:	0.015
Ps ("H2O):	-0.31	Pb (mbar):	5160	Ps ("H2O):	-0.21	Pb (mbar):	9160	measured / estimate	9160
Start Time:	1135	Stop Time:	1143	Start Time:	1245	Stop Time:	1252	Ps ("H2O):	-0.21
Post Test Pitot Leak Check Good?:	0.0021" H ₂ O		Post Test Pitot Leak Check Good?:	✓		Post Test Pitot Leak Check Good?:	✓		Stop Time:
Point #	Delta P	Ts	Notes	Point #	Delta P	Ts	Notes	Point #	Delta P
1	.27	178		1	.27	176		1	.27
2	.29	173		2	.27	178		2	.26
3	.24	174		3	.29	179		3	.28
4	.31	177		4	.31	180		4	.24
5	.34	178		5	.30	181		5	.26
6	.32	179		6	.31	182		6	.30
7	.28	126		7	.22	181		7	.25
8	.27	180		8	.28	182		8	.28
2-1	.25	177		2-1	.26	182		2-1	.25
2	.26	177		3	.28	182		3	.27
3	.27	178		4	.27	183		4	.29
4	.30	179		5	.28	183		5	.28
5	.32	180		6	.32	182		6	.32
6	.31	180		7	.33	182		7	.27
7	.29	181		8	.31	183		8	.27
8	.28	181							
Averages:	0.5101		Averages:	0.5127		Averages:	0.5127		Averages:
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		
	0.5101			0.5127			0.5127		
	171.3			181.4			181.4		
	Averaged:			Averaged:			Averaged:		</td

INLET RUNS 1-3

Air Pollution Testing Inc.: EPA Method 2 - Pilot Traverse Datasheet

Job #:	BDM 7096	Operator:	TK, TG	Stack Diameter (Inches):	23.25"
Facility:	BD Medical	Site :	Catalytic oxidizer	Upstream Disturbance (Inches):	~15'
Date:	7/12/17	Points :	1 5.8 5 20.7 9 2 7.4 6 23.7 10 3 9.5 7 25.8 11 4 12.5 8 27.5 12	Downstream Disturbance (Inches):	~10'
Probe ID:	P-497			Schematic of Sampling Location:	
Pilot Constant:	0.806 .821 05			Port = S u	
Run #:	1	Run #:	2	Run #:	3
O2%:	.21	O2%:	.21	O2%:	.21
H2O%:	0	H2O%:	0	CO2%:	0
Ps ("H2O):	measured / estimate	Ps ("H2O):	measured / estimate	CO2%:	0
Pb (mbar):	960	Pb (mbar):	-8.1	measured / estimate	
Start Time:	11446	Stop Time:	11516	Ps ("H2O):	960
Post Test Pilot Leak Check Good? Y.yes S.no	5-H2o	Post Test Pilot Leak Check Good? Y.yes S.no	4-H2o	Pb (mbar):	960
Point #	Delta P	Ts	Ts	Notes	Notes
Point #	Delta P	Ts	Ts	Notes	Notes
1-1	.21	74	74	1-1	77
2	.25	76	76	2	78
3	.23	76	76	3	78
4	.24	77	77	4	79
5	.24	76	76	5	79
6	.25	76	76	6	79
7	.26	77	77	7	79
8	.24	77	77	8	79
2-1	.23	75	75	2-1	77
2	.26	76	76	2	77
3	.27	78	78	3	77
4	.24	77	77	4	78
5	.25	77	77	5	77
6	.26	75	75	6	77
7	.24	76	76	7	78
8	.25	76	76	8	78

Averages: 0.4948

76.19

Averages: 0.4910

78.12

Averages:

0.4961

78.0

Reviewers Signature:

Run 1

Air Pollution Testing, Inc. : EPA Method 4 - Moisture Determination Datasheet

APT Job #: Bpm7096

Location: Catalytic Oxidizer

Date: 7/12/17

Operator: G

Run # 1

Meter Box ID: 175-13

Barometric Press (mbar): 960

Meter Box Y_d: 495-13 6.491

Post-Test Pump Leak Check: 0.00 C15 "Hg

Meter ΔH@: 1.60

Pre-Test Pump Leak Check: 0.00 C15 "Hg

Method: 4

Start Time: 12:30

Stop Time: 12:30

Sampling Time (minutes)

Vacuum (" Hg)

CO₂ (%): 0

Ambient Temperature (°F): ~75

Moisture (grams): 20.0

ΔH Orifice Setting (" H₂O)T_m Meter Temp.

Barometric Press (mbar): 960

Probe Length (ft): ~3'

Static Pressure ("H₂O): - 0.21

Start Time: 12:30

Stop Time: 12:30

Sampling Time (minutes)

Inlet (°F)

Schematic of Stack: 23.5"

Outlet (°F)

Notes

Condenser Temp. (°F)

Notes

Sampling Time (minutes)

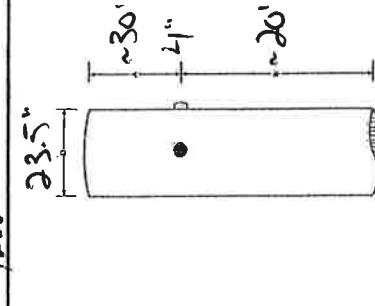
Probe Temp. (°F)

Notes

Sampling Time (minutes)

Initial Volume (ft³)

Notes



Stack ID (inches): 23.5"

Upstream Disturbance (inches): ~30'

Downstream Disturbance (inches): ~20'

200 gram Field Check of Scale (value):

Moisture Determination

Imp. #	Tare	Final	Gain
1	586.0	598.8	
2	562.2	565.8	
3	459.1	462.2	
4	645.7	655.3	
Total	2333.0	2322.6	29.0

Technician's Signature:

Project Leader's Signature:

maximum average
average

maximum average
average

maximum average
average

maximum average
average

Run 2

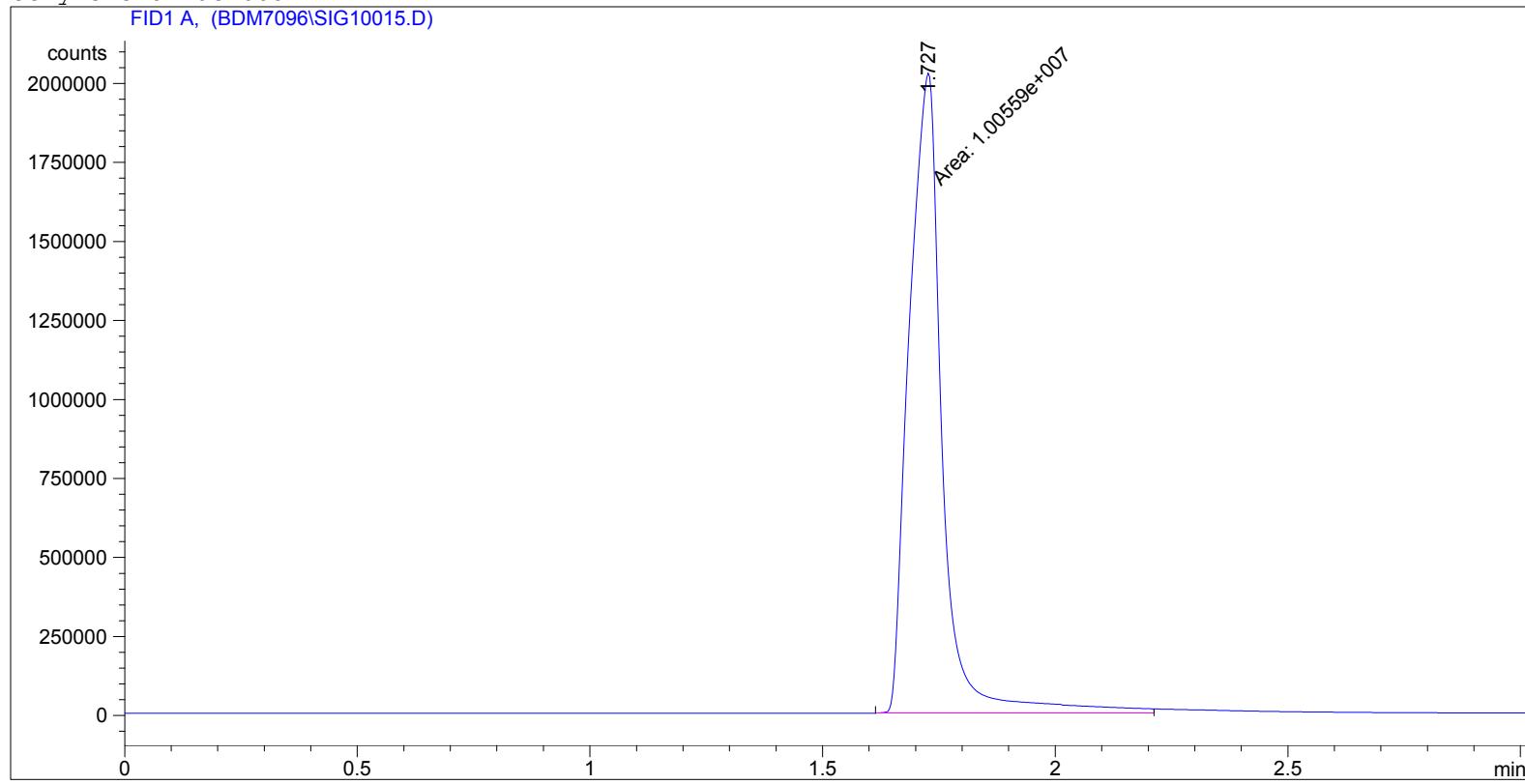
Air Pollution Testing, Inc. : EPA Method 4 - Moisture Determination Datasheet											
APT Job #:	BDM7096		Date:	7/12/17		CO ₂ (%):	6	O ₂ (%):	21		
Location:	Aalytic 041 d.2s		Operator:	TGJK		Ambient Temperature (°F):	~80		Barometric Press (mbar): 960		
Run #	2		Meter Box ID:	MS-13		Probe Length (ft):	~5'		Moisture (grams): 23.1		
Meter Box Y _d :	0.196		Meter ΔH@:	1.60		Static Pressure (°H ₂ O):	-0.21		Start Time: 1210		
Pre-Test Pump Leak Check:	0.0 at 5" H₂O		Post-Test Pump Leak Check:	6.0 at 10" H₂O		Method:	4		Stop Time: 1340		
Sampling Time	Vacuum (" Hg)	ΔH Orifice Setting (" H ₂ O)	T _m	Meter Temp.	Condenser Temp. (°F)	Probe Temp. (°F)	Volume (ft ³)	Notes			
(minutes)			Inlet	Outlet (°F)			Initial Volume:				
5	3	1.0	711	93	65	245	981.3				
10	3	1.0	711	63	63	212	984.1				
15	3	1.0	715	93	63	214	987.5				
20	3	1.0	715	93	63	214	987.5				
25	3	1.0	715	93	63	250	990.7				
30	3	1.0	716	93	63	251	993.9				
35	3	1.0	716	93	63	253	997.1				
40	3	1.0	716	93	63	250	1000.3				
45	3	1.0	716	62	62	251	1003.1				
50	3	1.0	711	62	60	252	1006.5				
55	3	1.0	711	92	60	252	1009.7				
60	3	1.0	711	92	61	252	1012.8				
						218	1016.003				
Stack ID (Inches): 43.5'											
Upstream Disturbance (inches): ~30'											
Downstream Disturbance (inches): ~20'											
200 gram Field Check of Scale (value):											
Moisture Determination											
								Imp. #	Tare		
								1	598.8		
								2	565.8		
								3	1162.2		
								4	655.2		
								Total	2282.0		
								Technician's Signature:	<u>Project Leader's Signature:</u>		
maximum average difference											
60	3	1.0	93.7	65	313.8	(37.9416)					

GC Chromatograms

Inlet Pre-Cal

Lineloss Inlet 5222 ppm EO Inj 3

```
=====
Injection Date : 7/11/2017 1:55:30 PM
Sample Name : Lineloss In I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.727	MM	0.0827	1.00559e7	2.02681e6	1.000e2

Totals : 1.00559e7 2.02681e6

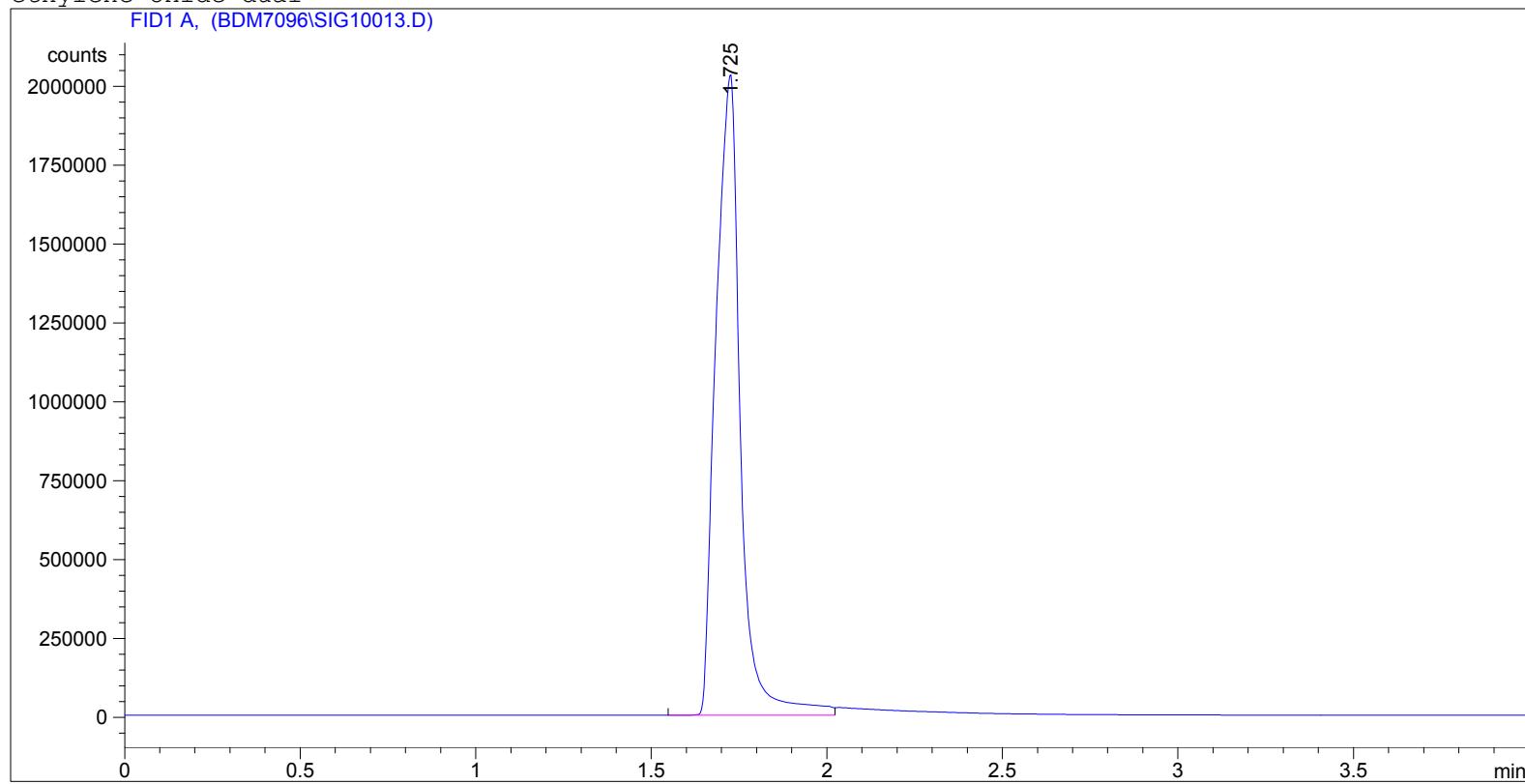
Results obtained with enhanced integrator!

=====

*** End of Report ***

Lineloss Inlet 5222 ppm EO Inj 2

```
=====
Injection Date : 7/11/2017 1:38:15 PM
Sample Name : Lineloss In I2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.725	VV	0.0797	9.86552e6	2.02970e6	1.000e2

Totals : 9.86552e6 2.02970e6

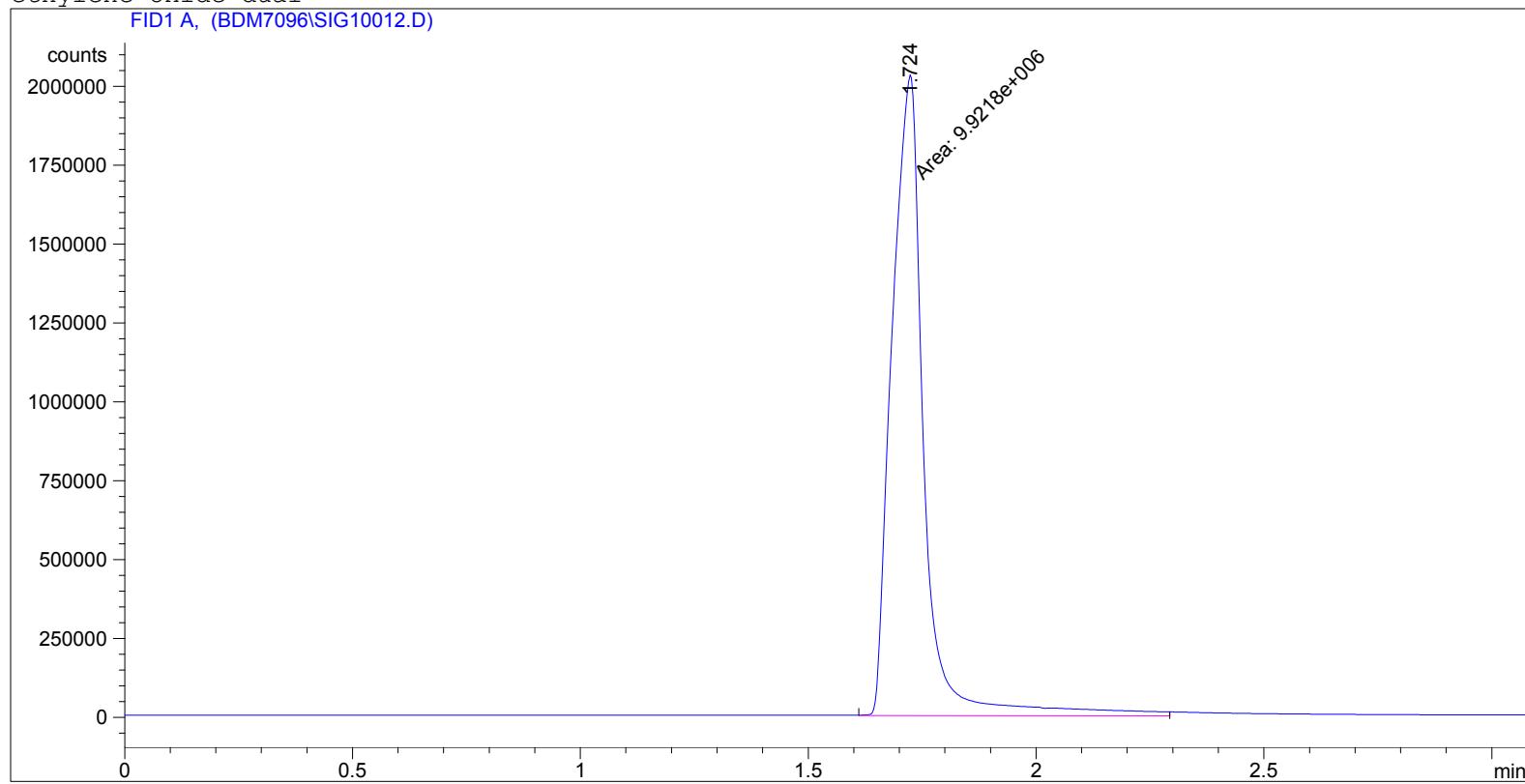
Results obtained with enhanced integrator!

=====

*** End of Report ***

Lineloss Inlet 5222 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 1:22:54 PM
Sample Name : Lineloss In II
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.724	MM	0.0814	9.92180e6	2.03202e6	1.000e2

Totals : 9.92180e6 2.03202e6

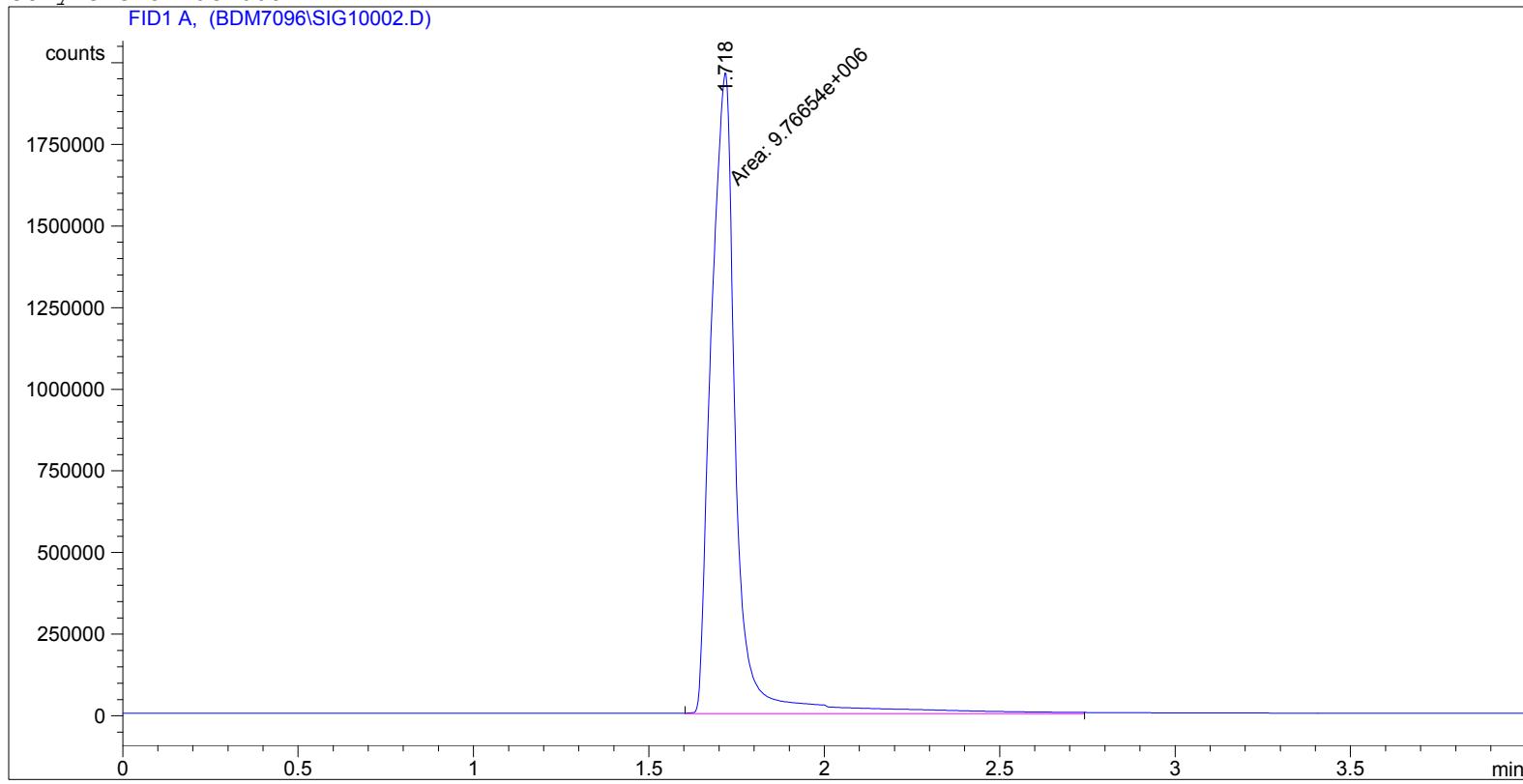
Results obtained with enhanced integrator!

=====

*** End of Report ***

5222 ppm EO Inj 3

=====
Injection Date : 7/11/2017 11:16:50 AM
Sample Name : 5222 ppm EO I3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.718	MM	0.0828	9.76654e6	1.96502e6	1.000e2

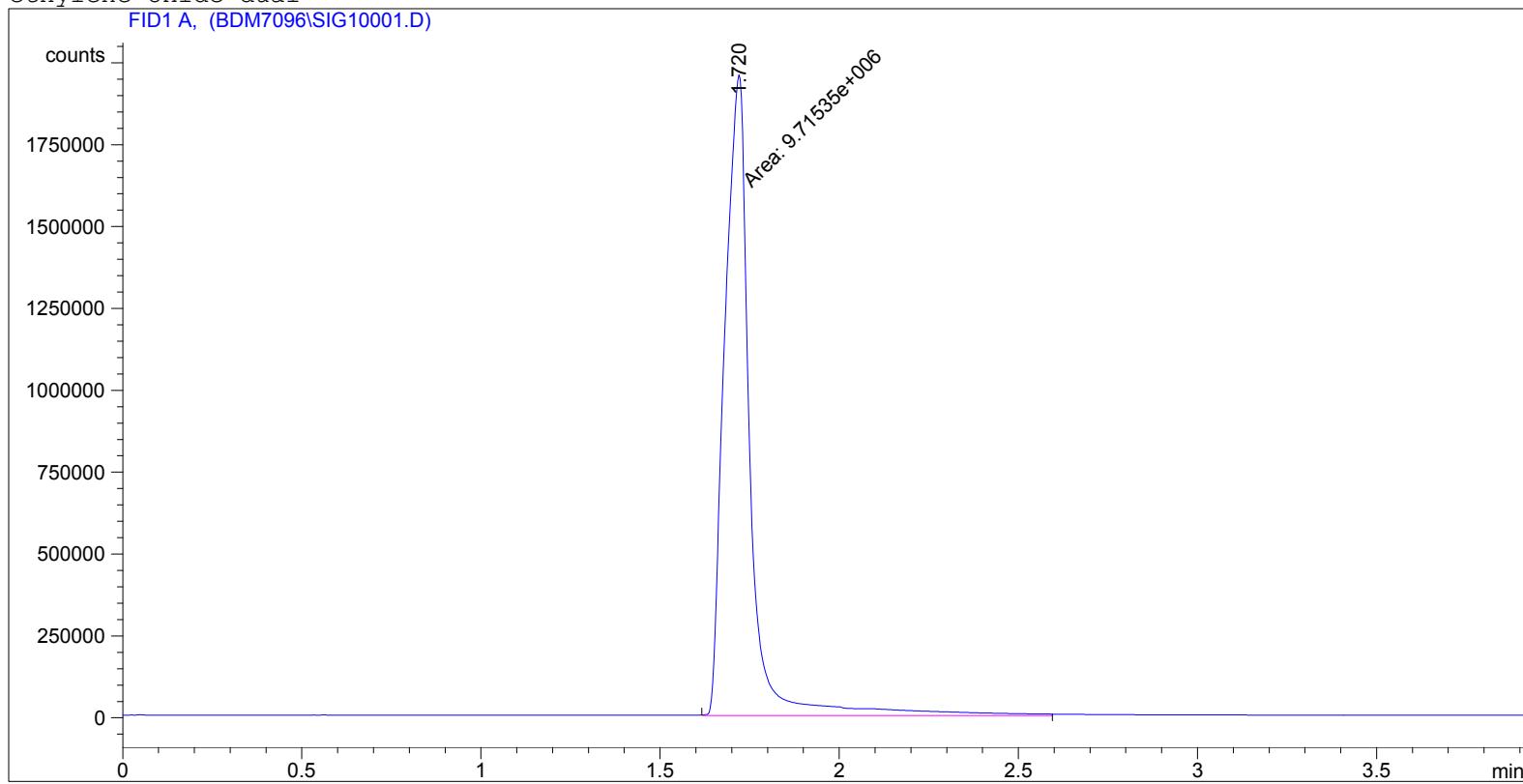
Totals : 9.76654e6 1.96502e6

Results obtained with enhanced integrator!

=====
*** End of Report ***

5222 ppm EO Inj 2

```
=====
Injection Date : 7/11/2017 11:09:48 AM
Sample Name : 5222 ppm EO I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.720	MM	0.0827	9.71535e6	1.95731e6	1.000e2

Totals : 9.71535e6 1.95731e6

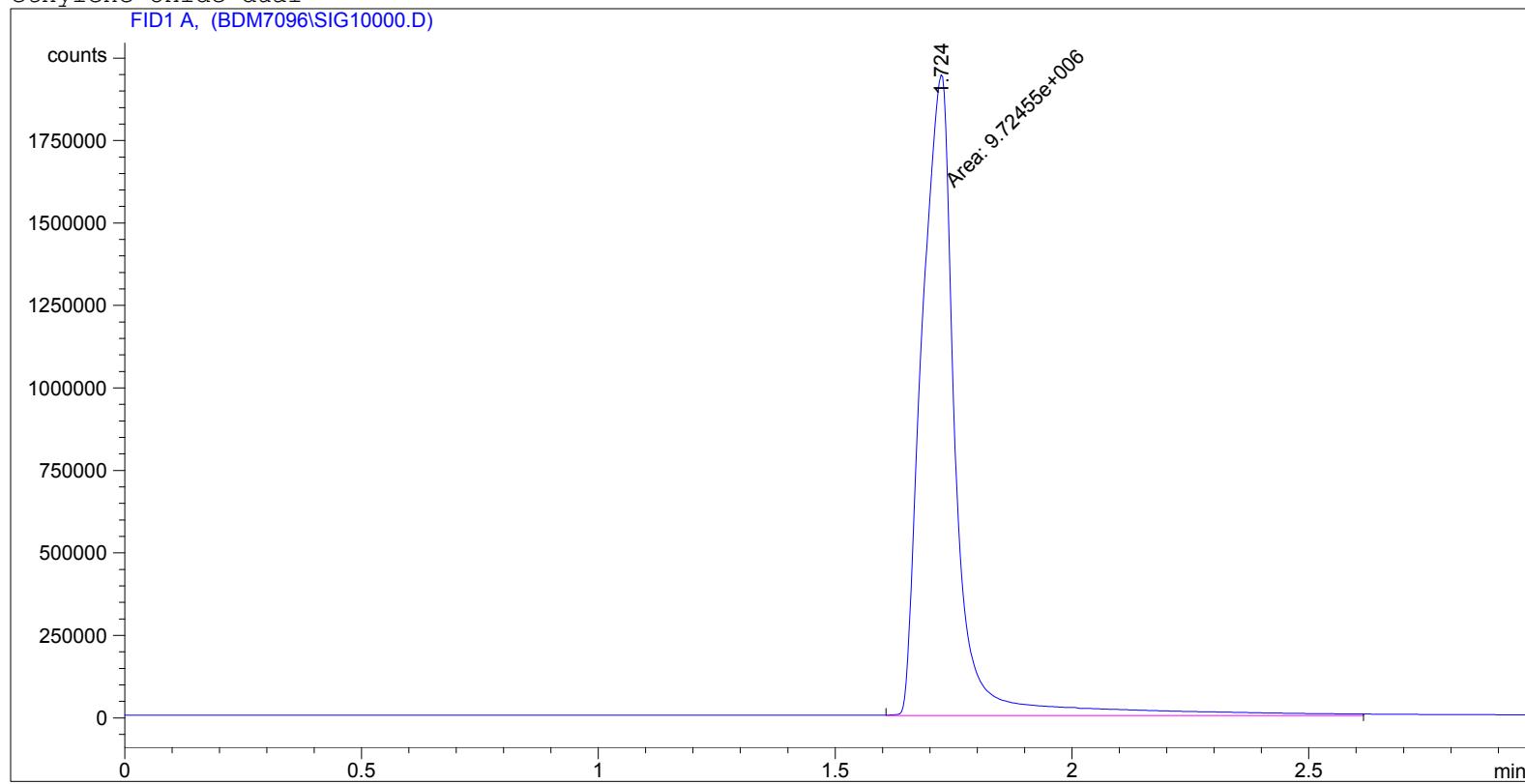
Results obtained with enhanced integrator!

=====

*** End of Report ***

5222 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 10:52:12 AM
Sample Name : 5222 ppm EO II
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.724	MM	0.0834	9.72455e6	1.94381e6	1.000e2

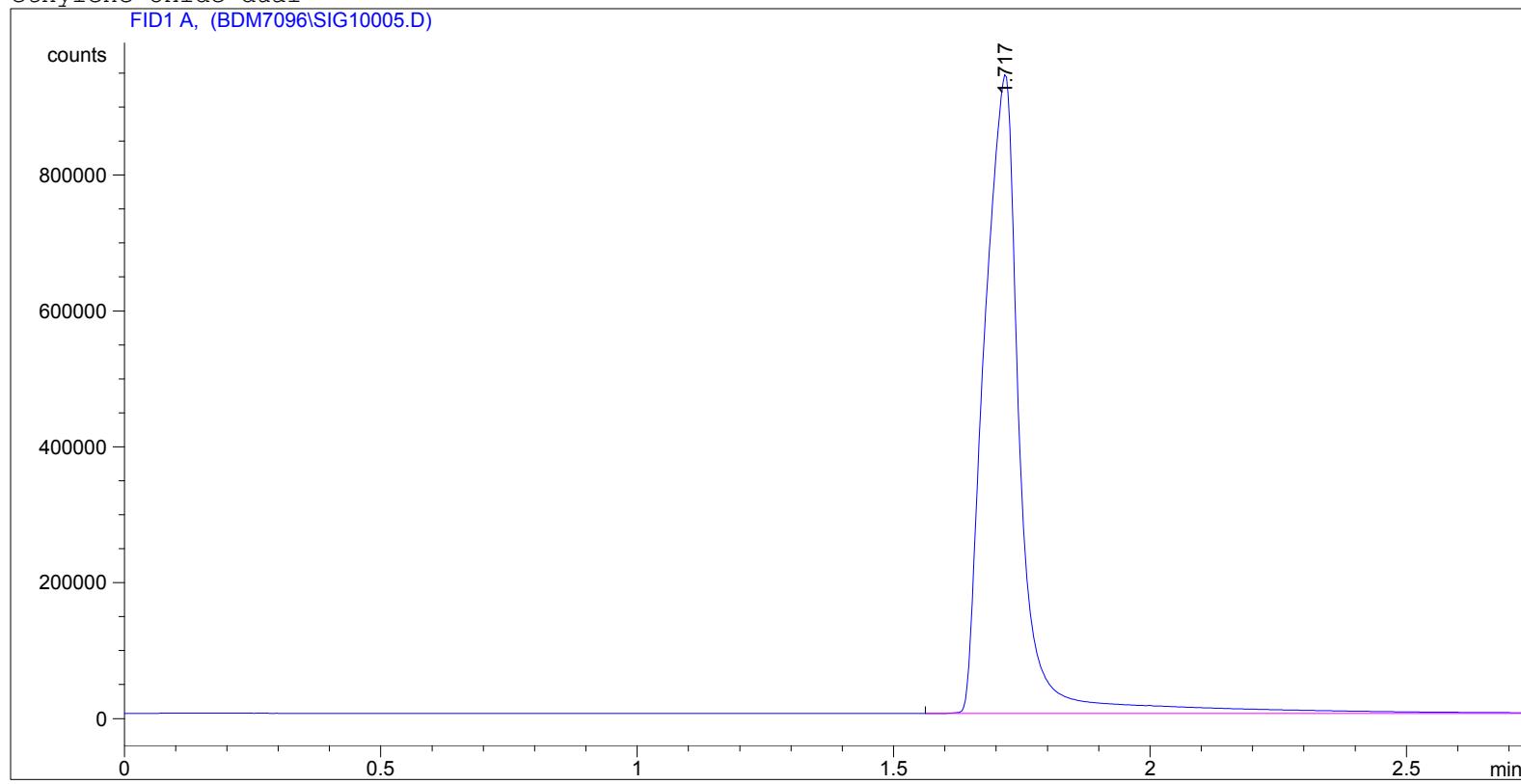
Totals : 9.72455e6 1.94381e6

Results obtained with enhanced integrator!

=====
*** End of Report ***

2611 ppm EO Inj 3

```
=====
Injection Date : 7/11/2017 11:59:57 AM
Sample Name : 2611 ppm EO I3
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	VBA	0.0793	4.61724e6	9.40380e5	1.000e2

Totals : 4.61724e6 9.40380e5

Results obtained with enhanced integrator!

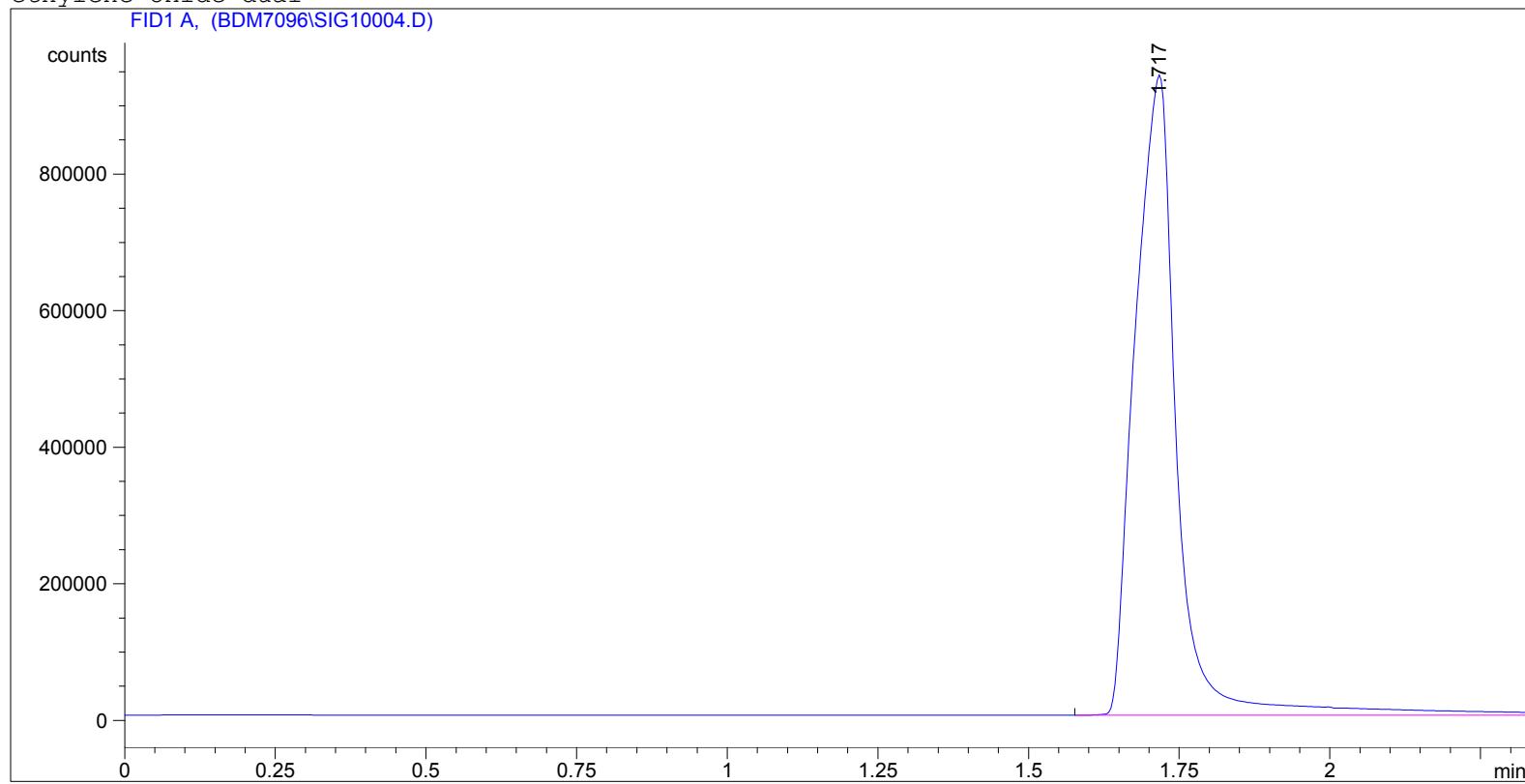
=====

*** End of Report ***

2611 ppm EO Inj 2

=====

Injection Date : 7/11/2017 11:54:45 AM
Sample Name : 2611 ppm EO I2 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	VBA	0.0796	4.55156e6	9.37842e5	1.000e2

Totals : 4.55156e6 9.37842e5

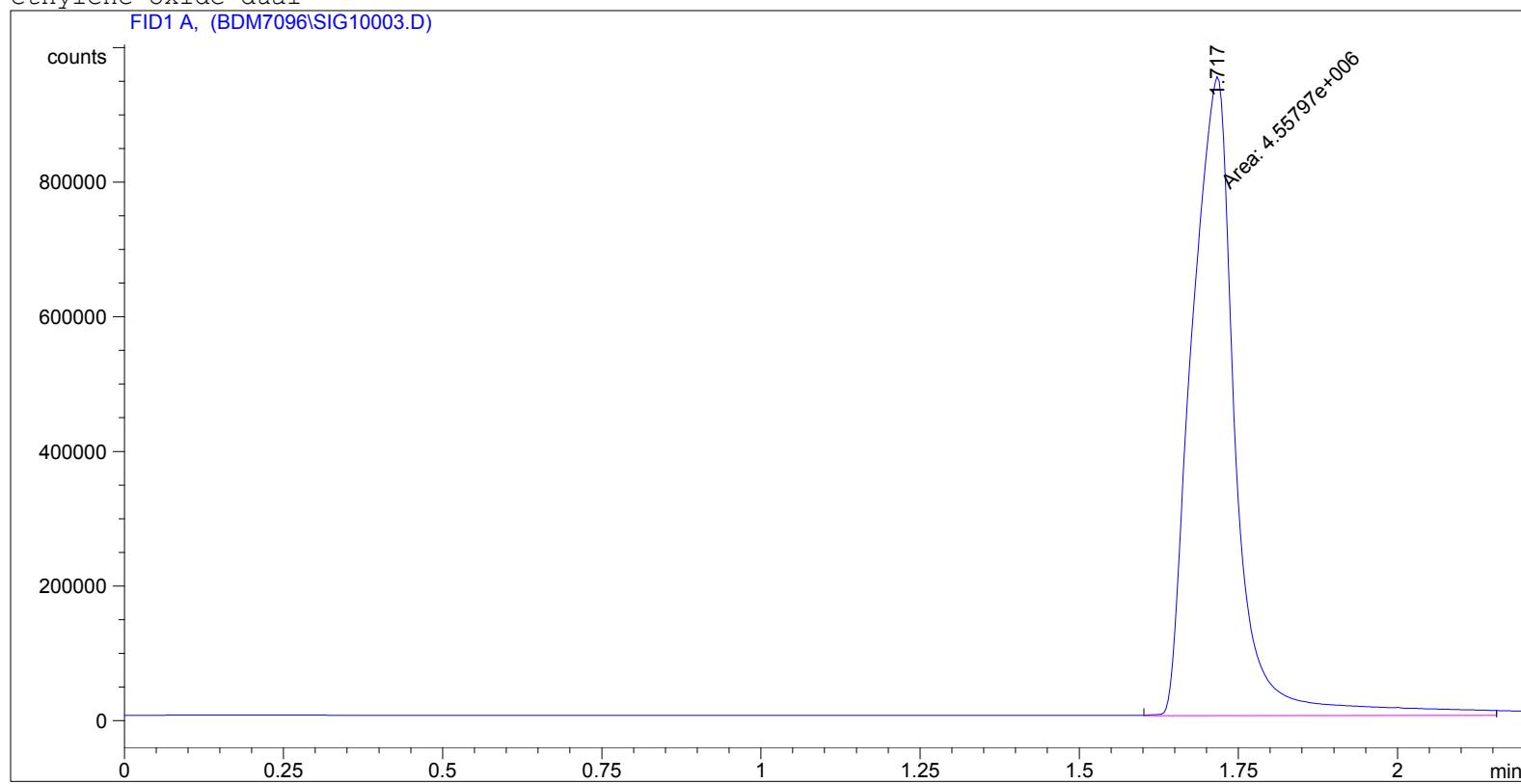
Results obtained with enhanced integrator!

=====

*** End of Report ***

2611 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 11:32:45 AM
Sample Name : 2611 ppm EO II
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.717	MM	0.0800	4.55797e6	9.49887e5	1.000e2

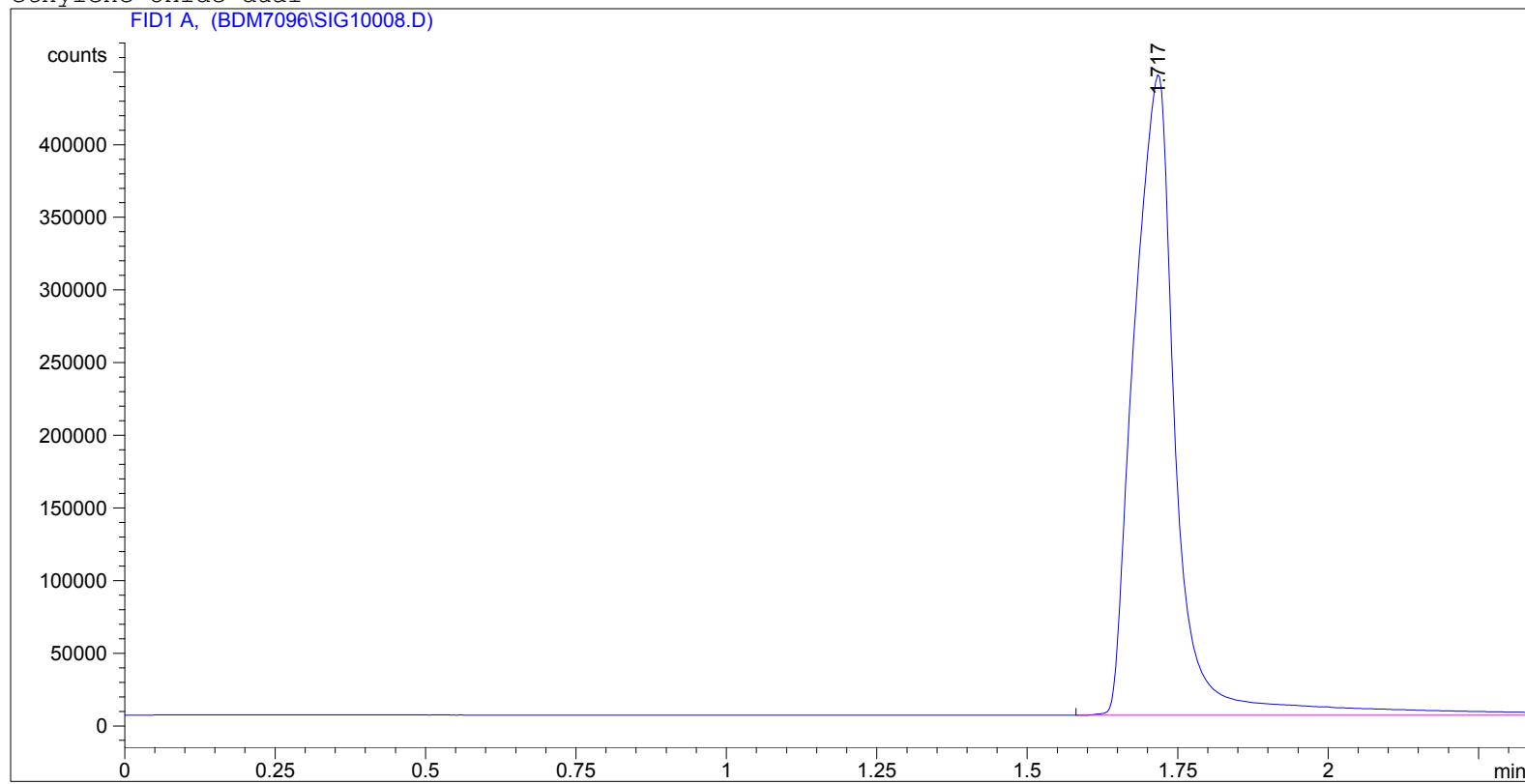
Totals : 4.55797e6 9.49887e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

1305.5 ppm EO Inj 3

```
=====
Injection Date : 7/11/2017 12:23:58 PM
Sample Name : 1305.5 ppm EO I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	VBA	0.0789	2.14821e6	4.40818e5	1.000e2

Totals : 2.14821e6 4.40818e5

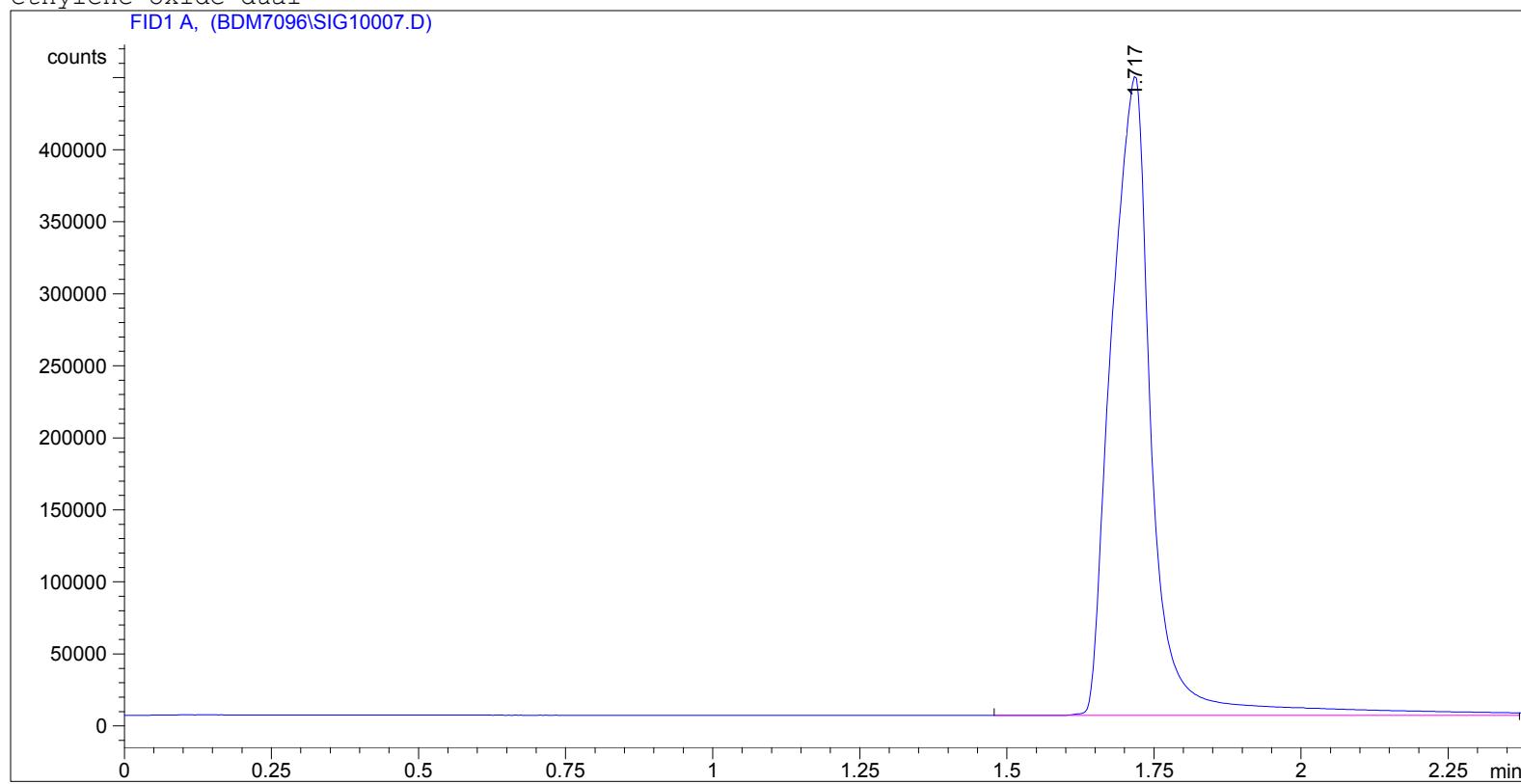
Results obtained with enhanced integrator!

=====

*** End of Report ***

1305.5 ppm EO Inj 2

```
=====
Injection Date : 7/11/2017 12:17:54 PM
Sample Name : 1305.5 ppm EO I2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	VV	0.0786	2.15295e6	4.43445e5	1.000e2

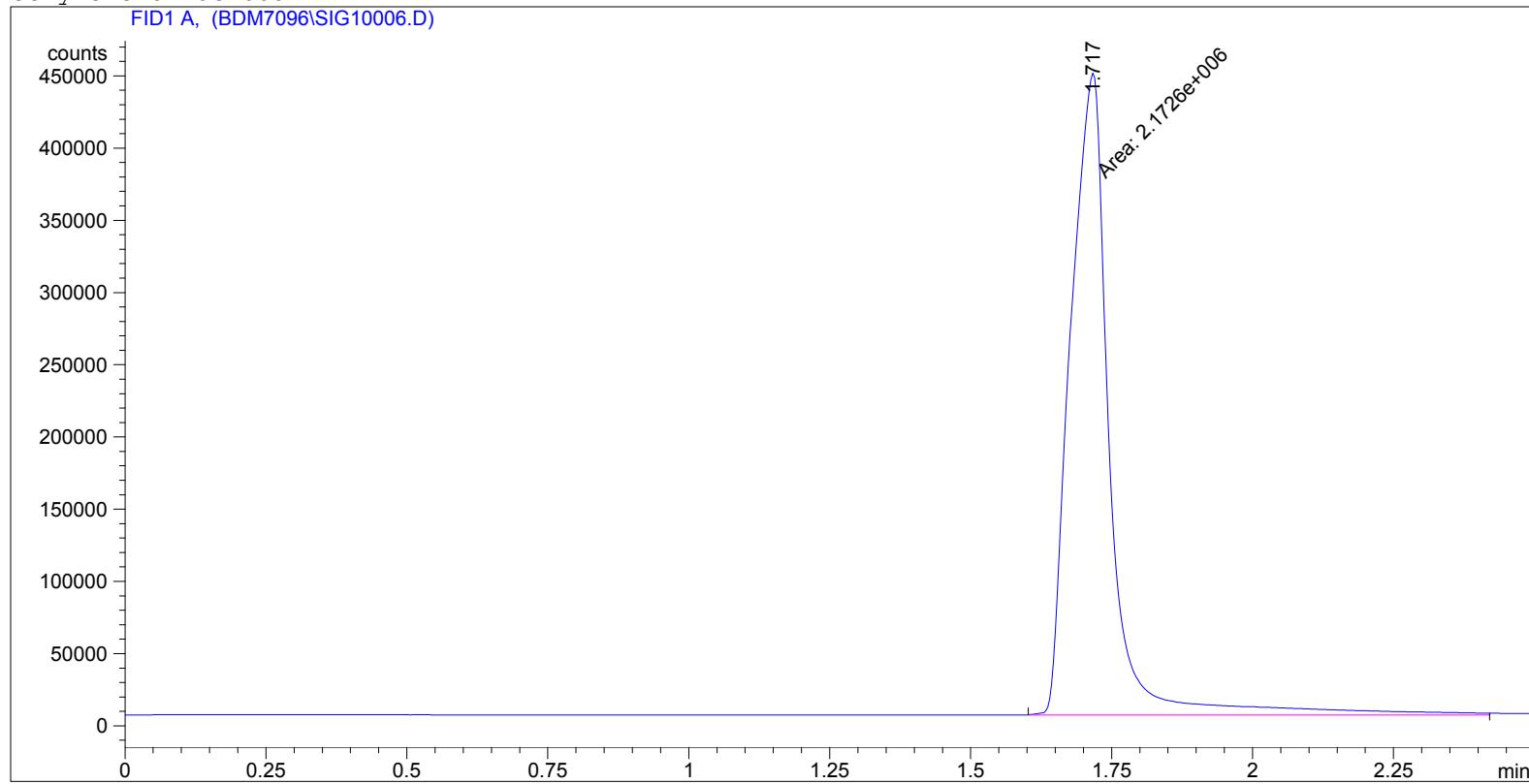
Totals : 2.15295e6 4.43445e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

1305.5 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 12:06:25 PM
Sample Name : 1305.5 ppm EO II
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	MM	0.0814	2.17260e6	4.44788e5	1.000e2

Totals : 2.17260e6 4.44788e5

Results obtained with enhanced integrator!

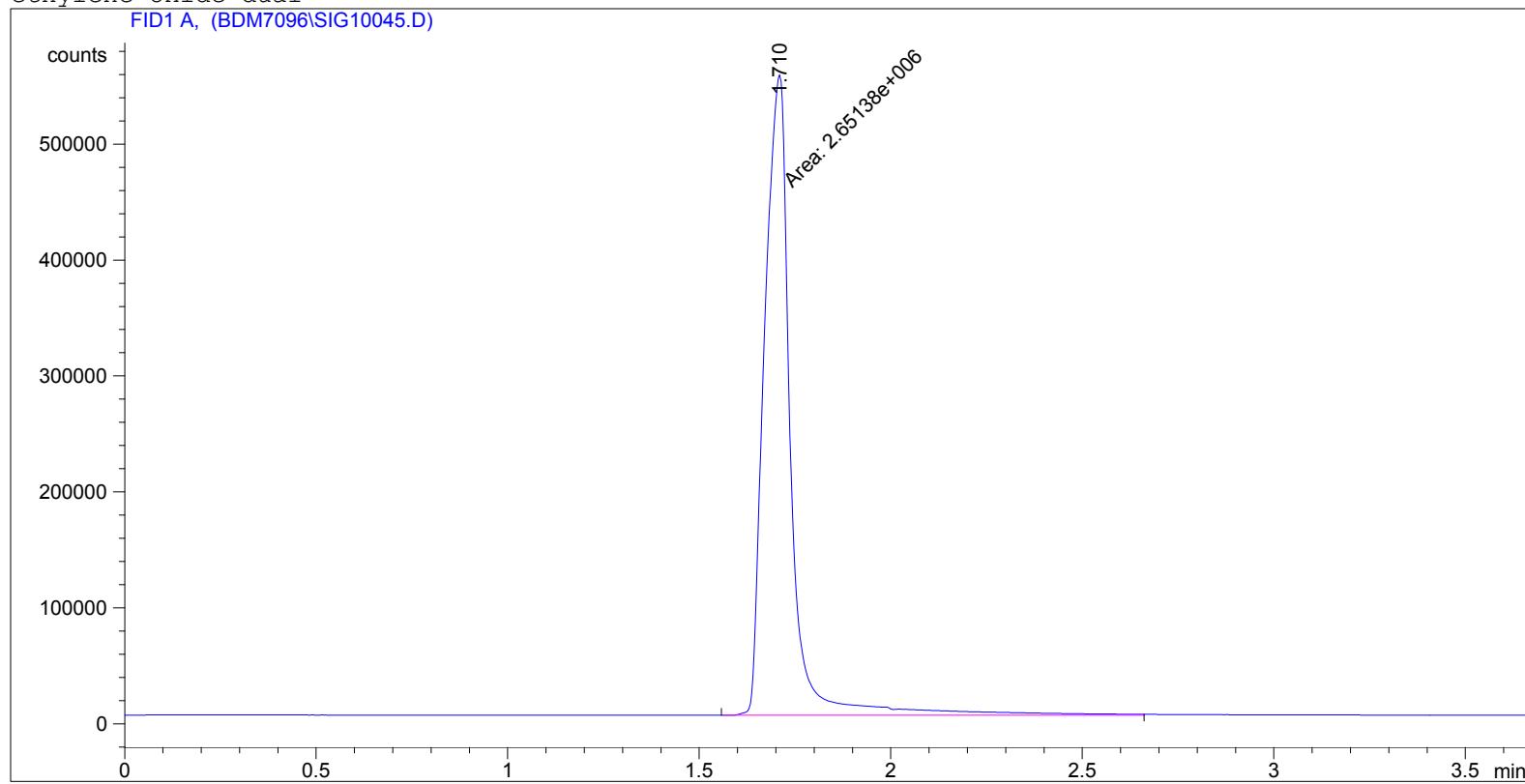
=====

*** End of Report ***

Inlet Runs

Inlet Run 3 Inj 5

=====
Injection Date : 7/12/2017 2:36:09 PM
Sample Name : Inlet Run 3 I5 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.710	MF	0.0799	2.65138e6	5.52721e5	1.000e2

Totals : 2.65138e6 5.52721e5

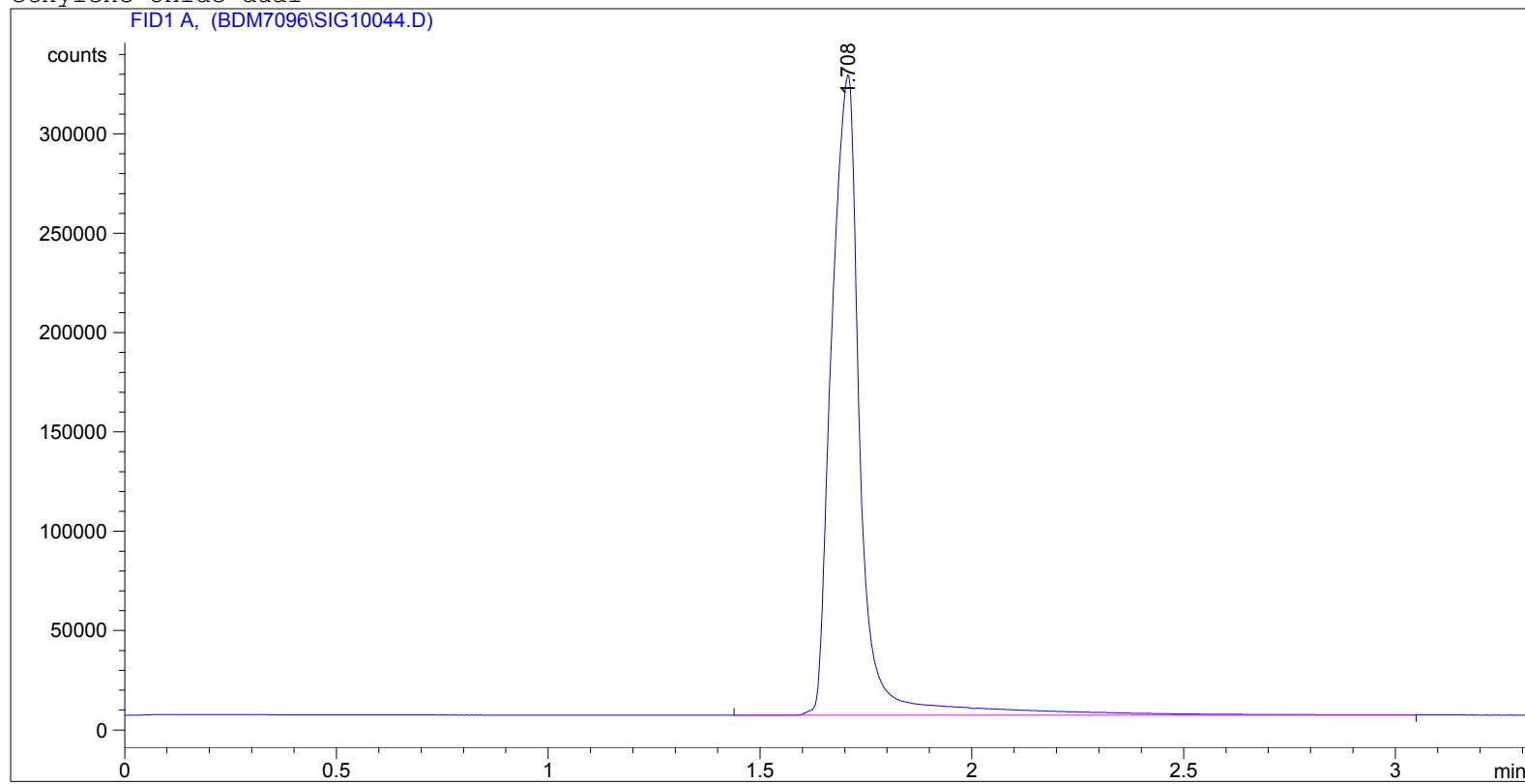
Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 3 Inj 4

=====

Injection Date : 7/12/2017 2:26:52 PM
Sample Name : Inlet Run 3 I4 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.708	VV R	0.0777	1.54089e6	3.22449e5	1.000e2

Totals : 1.54089e6 3.22449e5

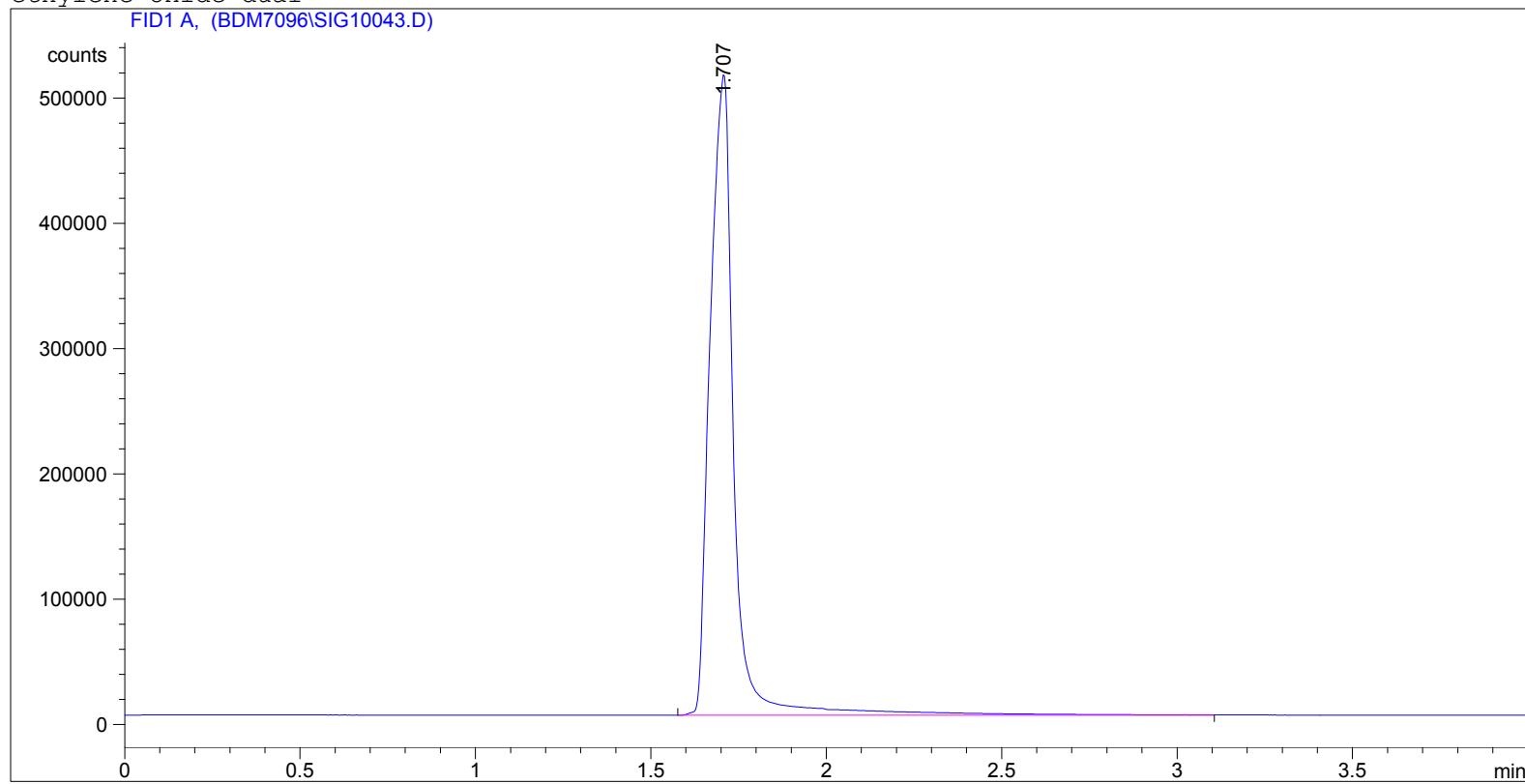
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 3

=====
Injection Date : 7/12/2017 2:14:05 PM
Sample Name : Inlet Run 3 I3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.707	VV R	0.0773	2.42876e6	5.11141e5	1.000e2

Totals : 2.42876e6 5.11141e5

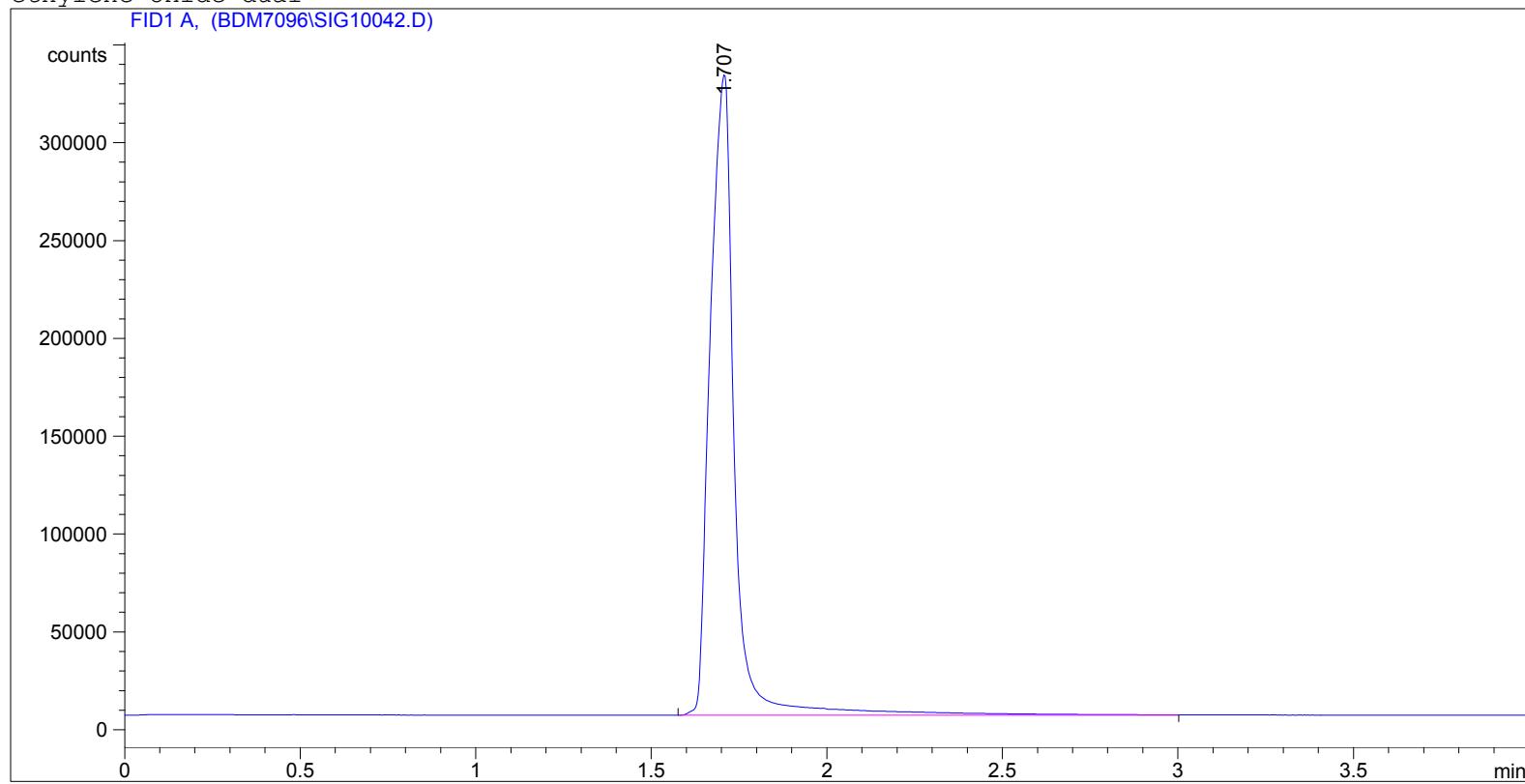
Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 3 Inj 2

=====

Injection Date : 7/12/2017 2:00:57 PM
Sample Name : Inlet Run 3 I2 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.707	VV	0.0775	1.58612e6	3.27308e5	1.000e2

Totals : 1.58612e6 3.27308e5

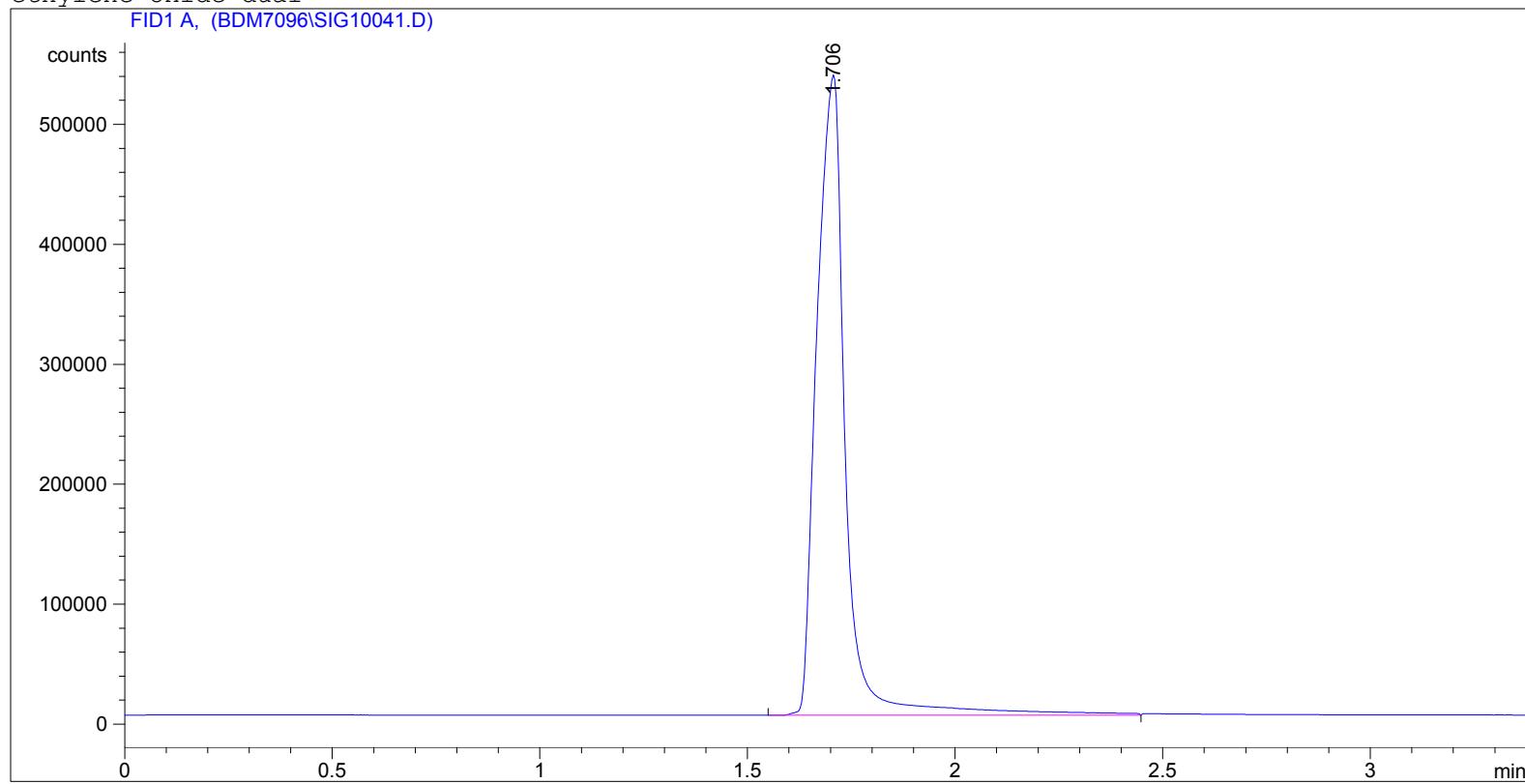
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 1

=====
Injection Date : 7/12/2017 1:48:43 PM
Sample Name : Inlet Run 3 II Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.706	VV	0.0781	2.56919e6	5.33866e5	1.000e2

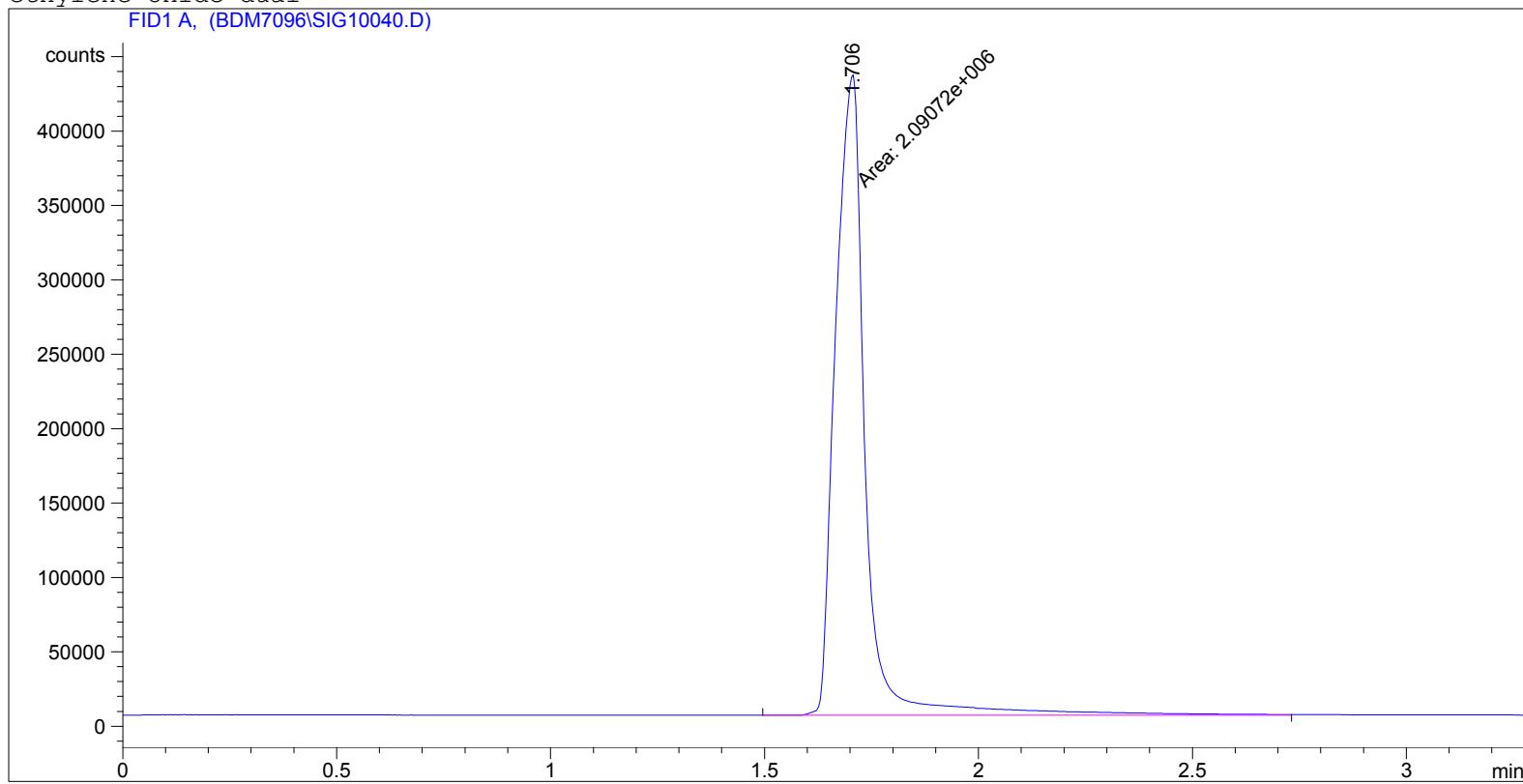
Totals : 2.56919e6 5.33866e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 2 Inj 5

```
=====
Injection Date : 7/12/2017 1:34:29 PM
Sample Name : Inlet Run 2 I5
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.706	MF	0.0809	2.09072e6	4.30943e5	1.000e2

Totals : 2.09072e6 4.30943e5

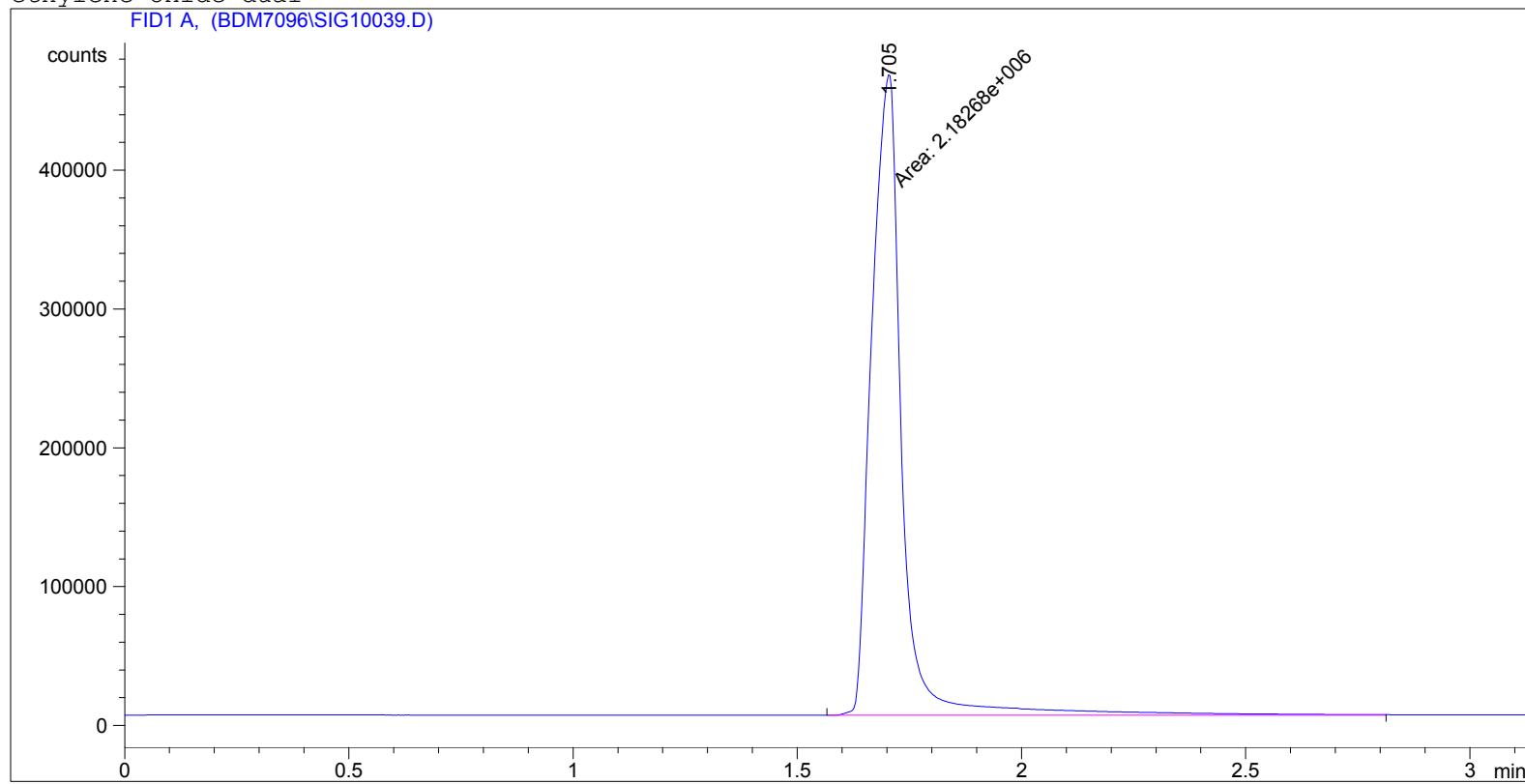
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 4

```
=====
Injection Date : 7/12/2017 1:21:38 PM
Sample Name : Inlet Run 2 I4
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.705	MF	0.0788	2.18268e6	4.61893e5	1.000e2

Totals : 2.18268e6 4.61893e5

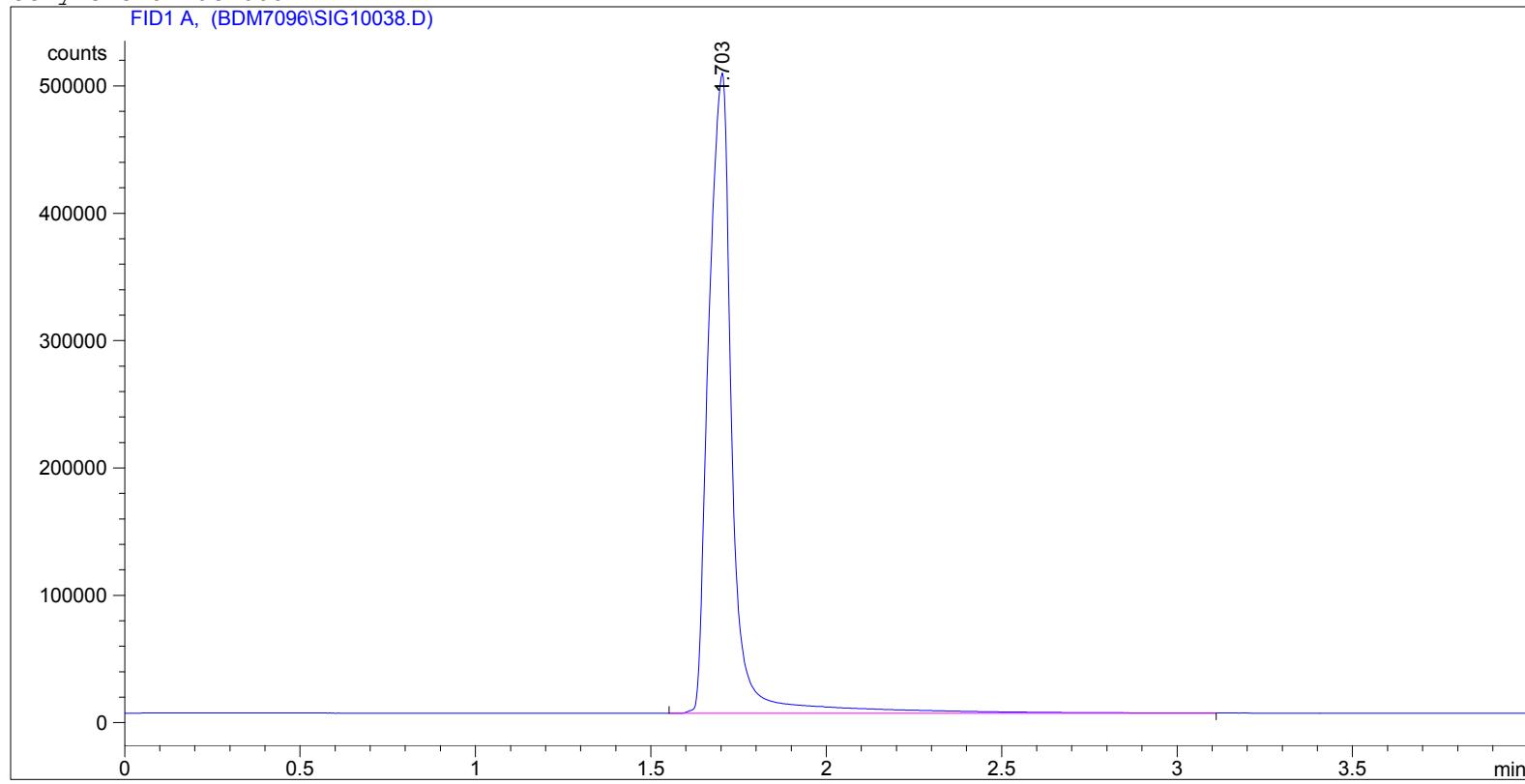
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 3

=====
Injection Date : 7/12/2017 1:09:52 PM
Sample Name : Inlet Run 2 I3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.703	VV	0.0760	2.37218e6	5.02786e5	1.000e2

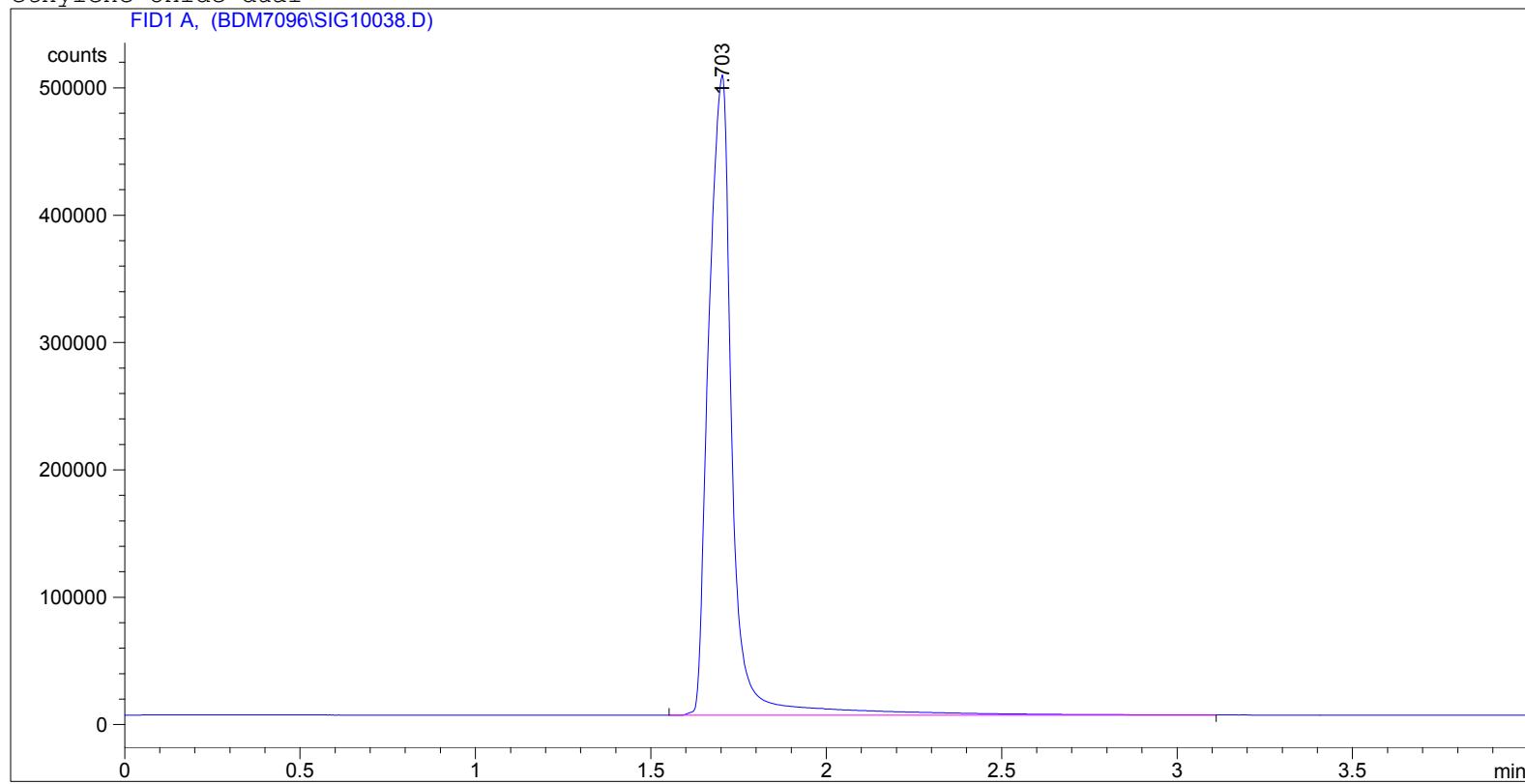
Totals : 2.37218e6 5.02786e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 2 Inj 3

=====
Injection Date : 7/12/2017 1:09:52 PM
Sample Name : Inlet Run 2 I3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.703	VV	0.0760	2.37218e6	5.02786e5	1.000e2

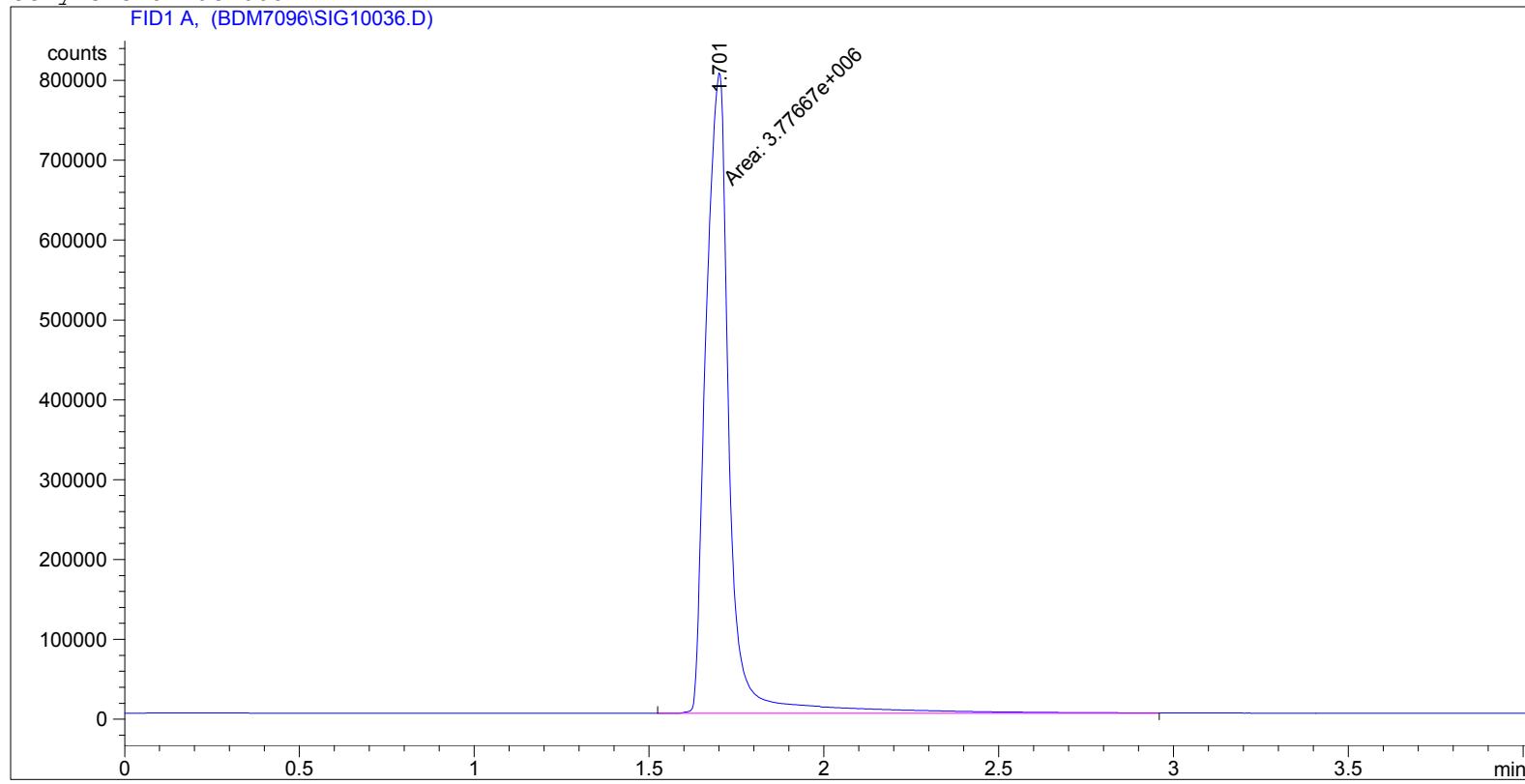
Totals : 2.37218e6 5.02786e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 2 Inj 1

=====
Injection Date : 7/12/2017 12:41:53 PM
Sample Name : Inlet Run 2 II Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.701	MF	0.0784	3.77667e6	8.02840e5	1.000e2

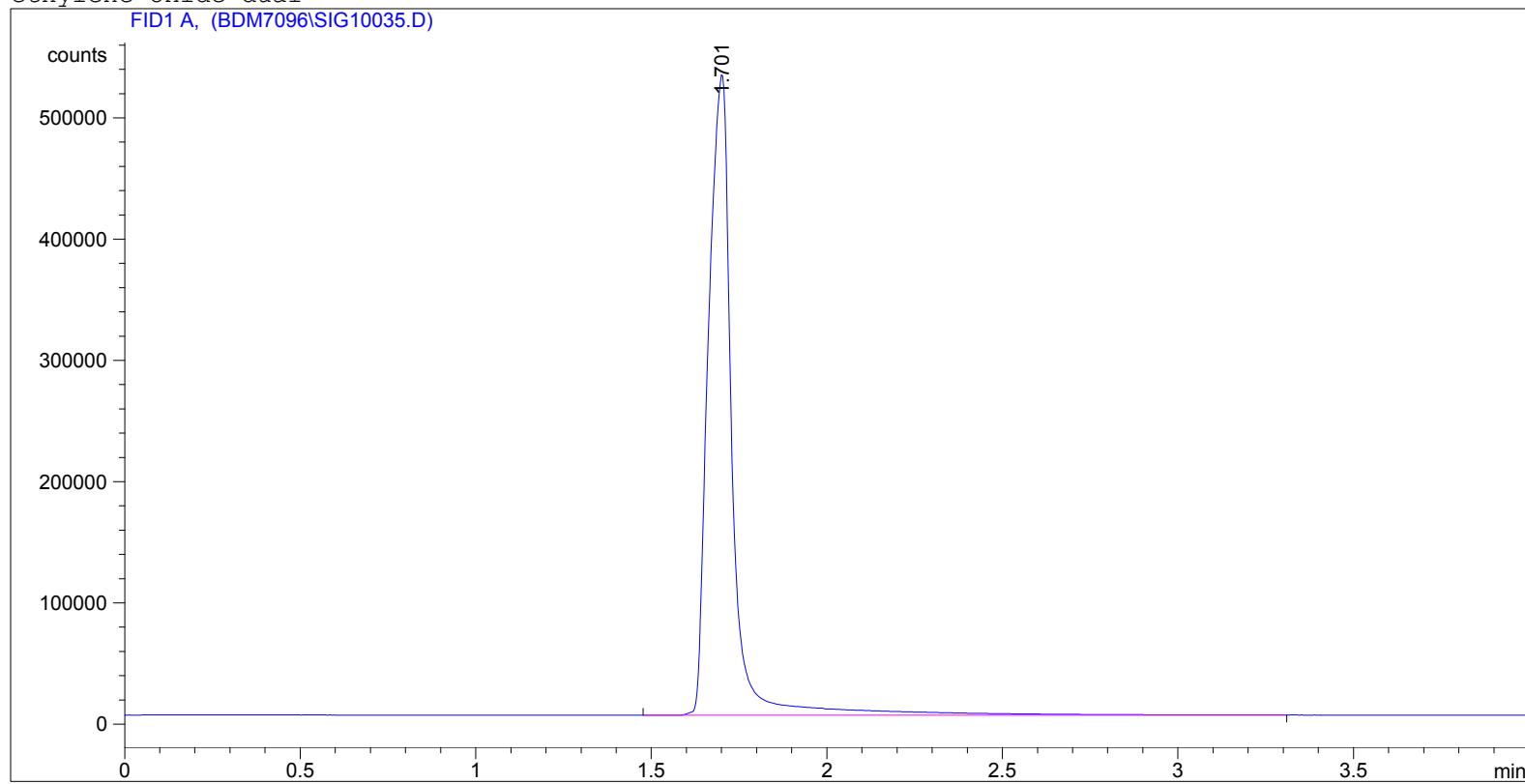
Totals : 3.77667e6 8.02840e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 1 Inj 6 Extra

```
=====
Injection Date : 7/12/2017 12:26:47 PM
Sample Name : Inlet Run I6
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.701	VV	0.0765	2.51433e6	5.28201e5	1.000e2

Totals : 2.51433e6 5.28201e5

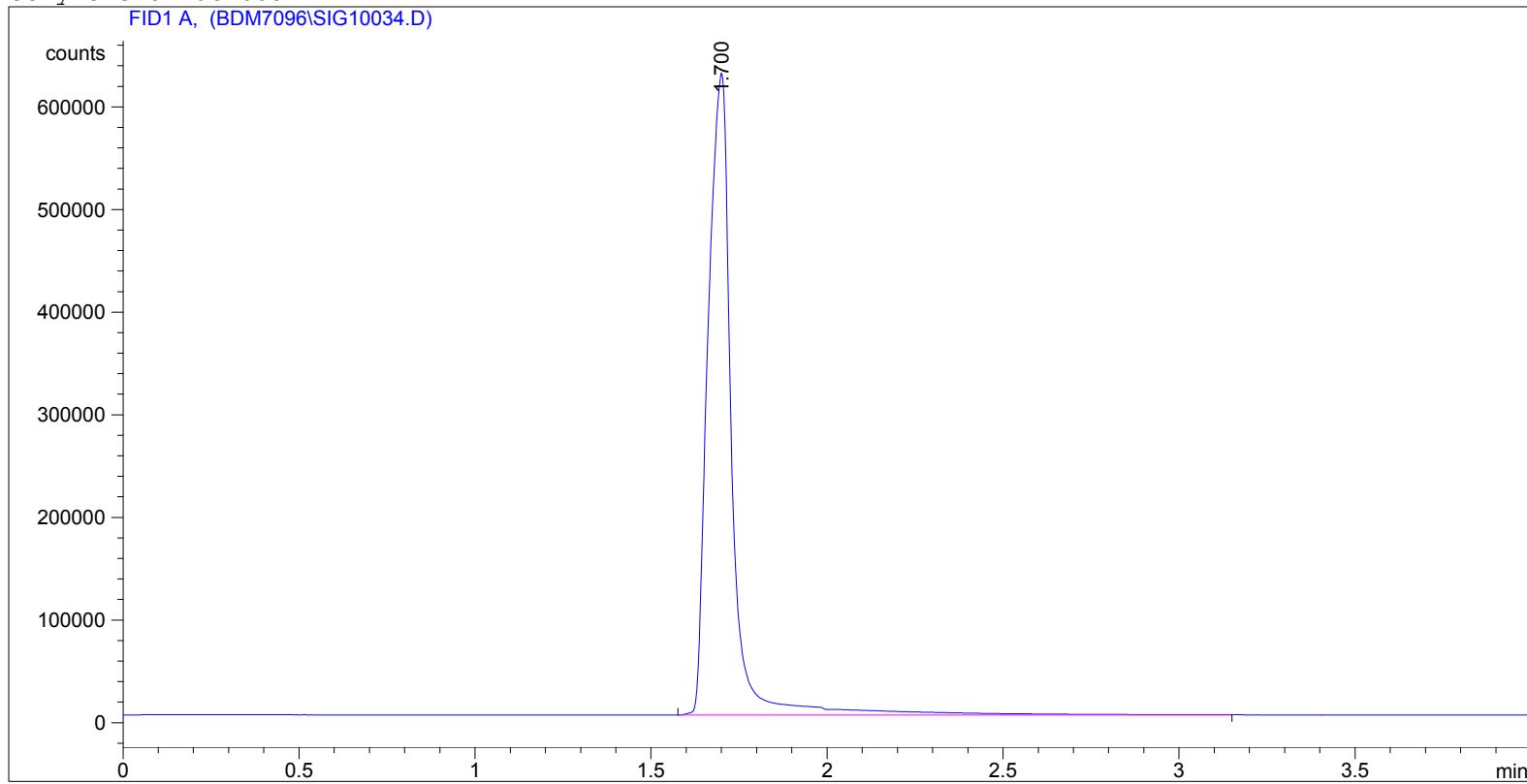
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 1 Inj 5

=====
Injection Date : 7/12/2017 12:17:49 PM
Sample Name : Inlet Run I5 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.700	VV R	0.0774	2.97357e6	6.25414e5	1.000e2

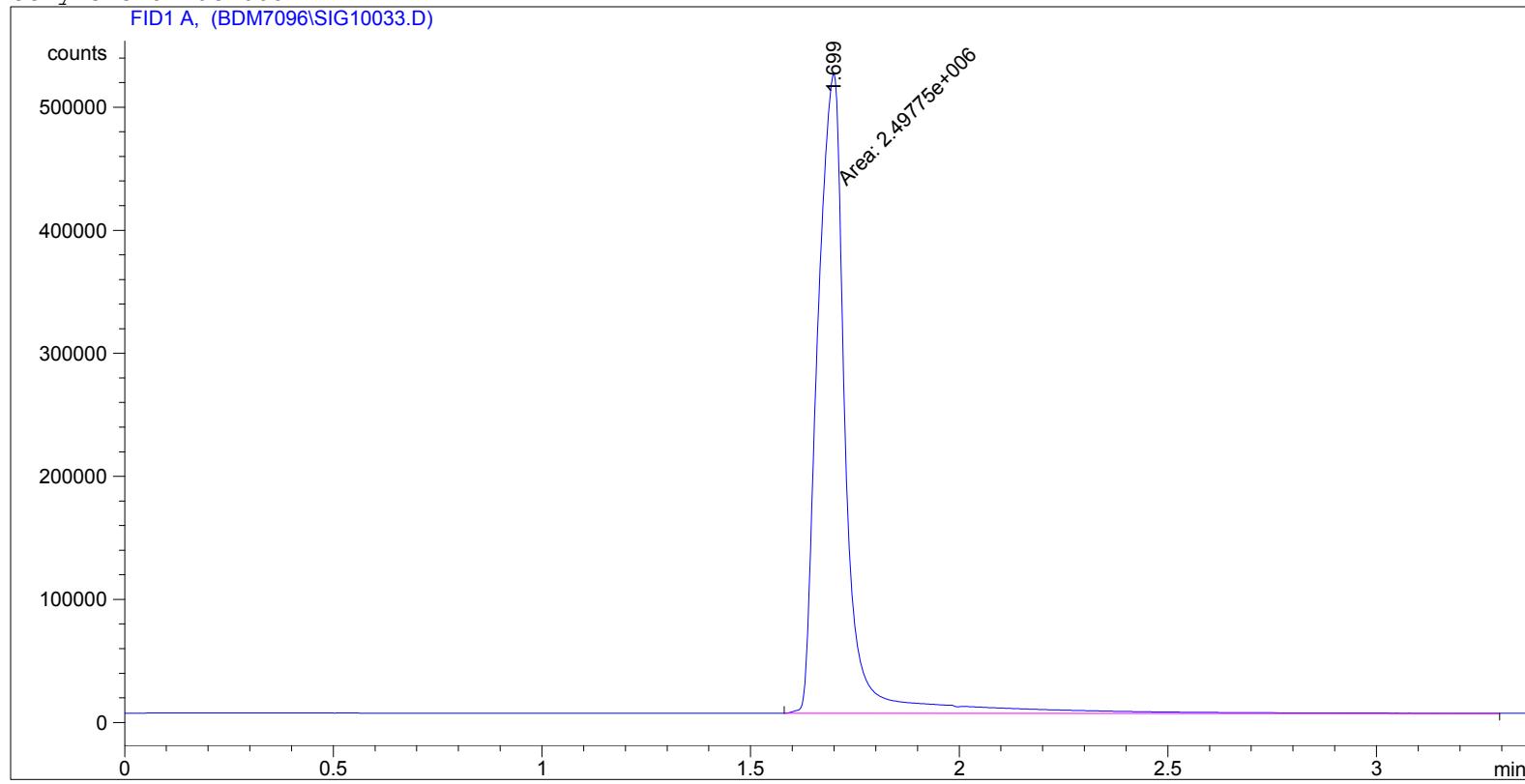
Totals : 2.97357e6 6.25414e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 1 Inj 4

=====
Injection Date : 7/12/2017 12:09:01 PM
Sample Name : Inlet Run I4 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.699	MM	0.0799	2.49775e6	5.20935e5	1.000e2

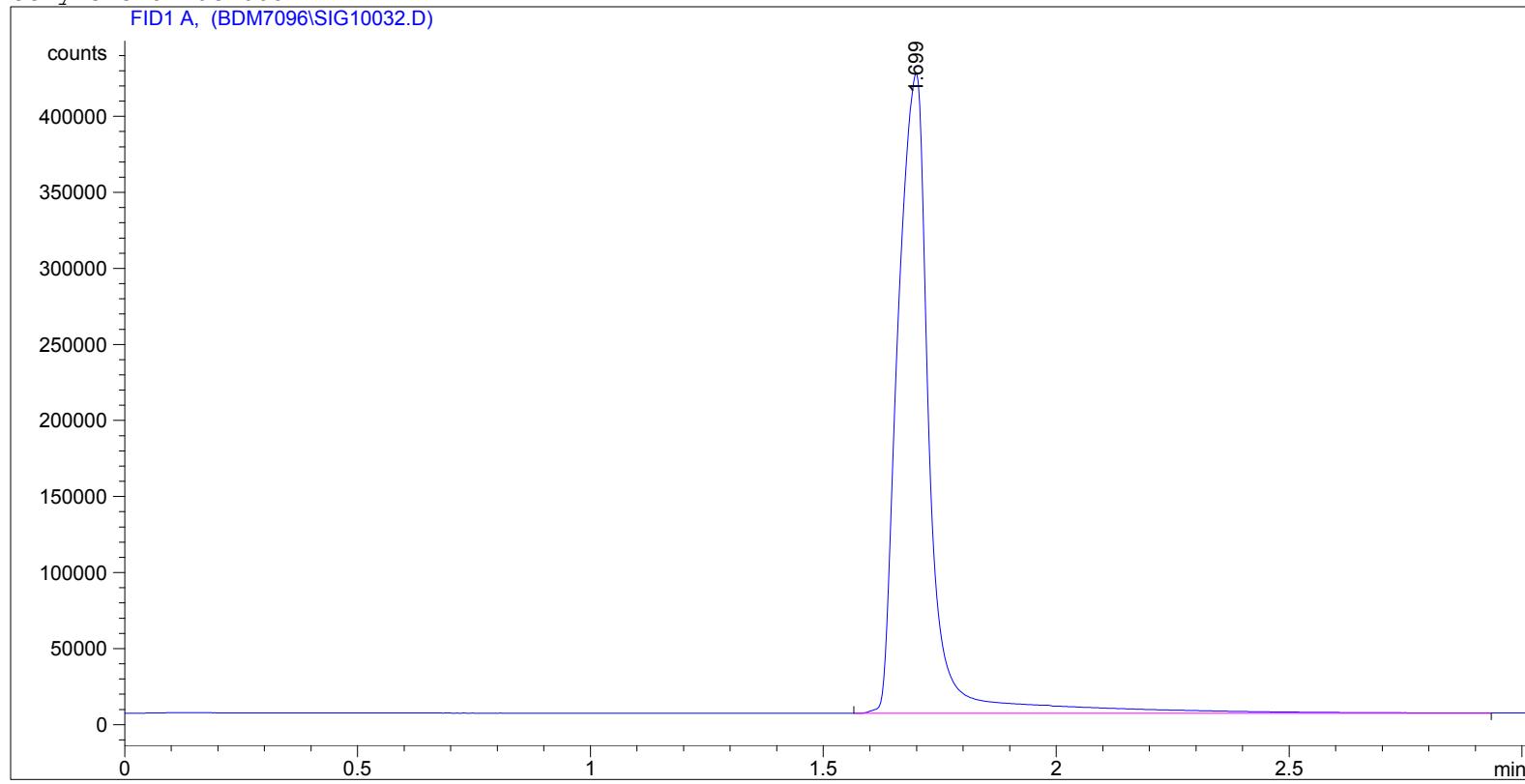
Totals : 2.49775e6 5.20935e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 1 Inj 3

=====
Injection Date : 7/12/2017 12:00:07 PM
Sample Name : Inlet Run I3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.699	VV	0.0768	2.01640e6	4.21686e5	1.000e2

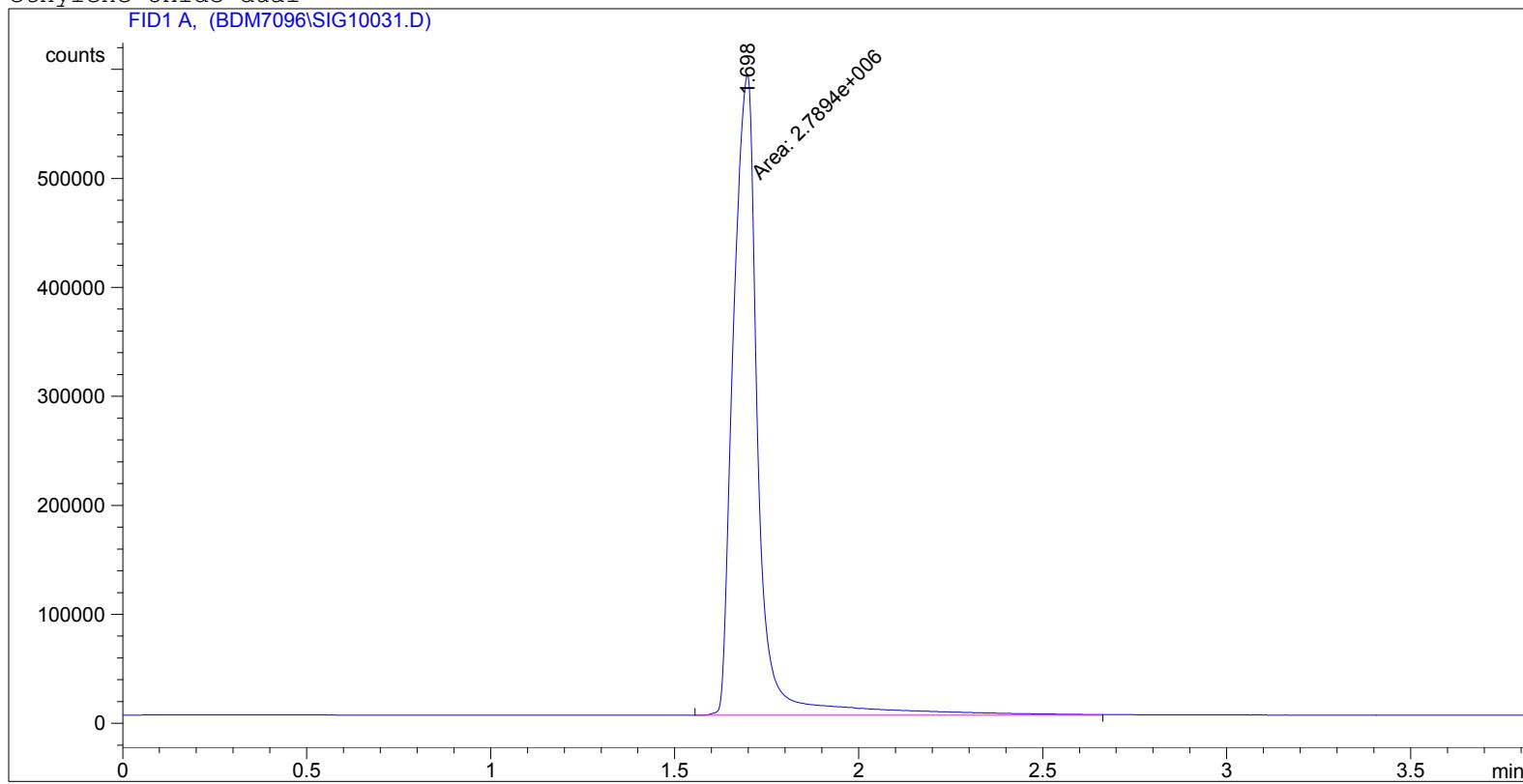
Totals : 2.01640e6 4.21686e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 1 Inj 2

=====
Injection Date : 7/12/2017 11:51:09 AM
Sample Name : Inlet Run I2 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.698	MF	0.0790	2.78940e6	5.88246e5	1.000e2

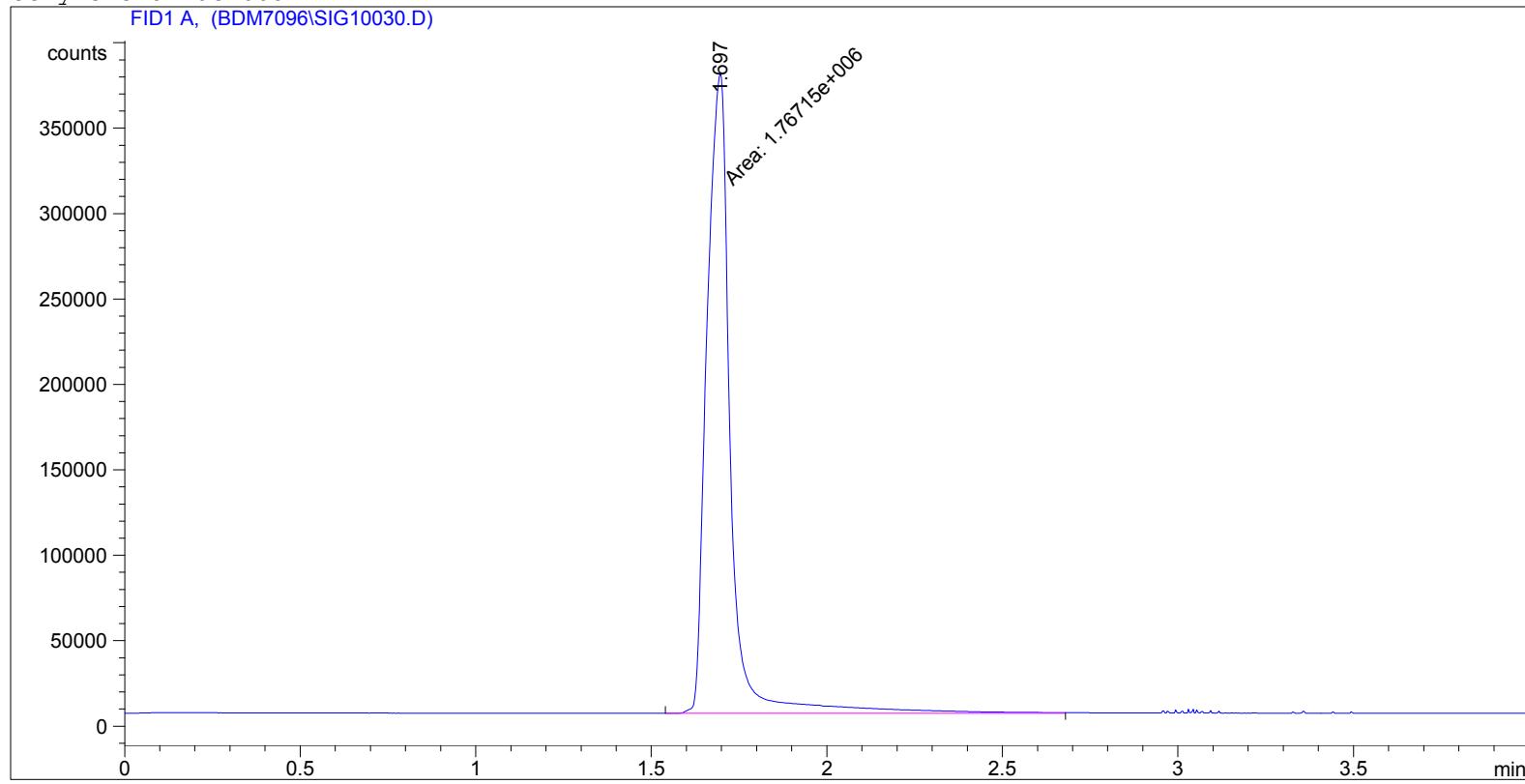
Totals : 2.78940e6 5.88246e5

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Run 1 Inj 1

=====
Injection Date : 7/12/2017 11:32:10 AM
Sample Name : Inlet Run II Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.697	MF	0.0785	1.76715e6	3.75010e5	1.000e2

Totals : 1.76715e6 3.75010e5

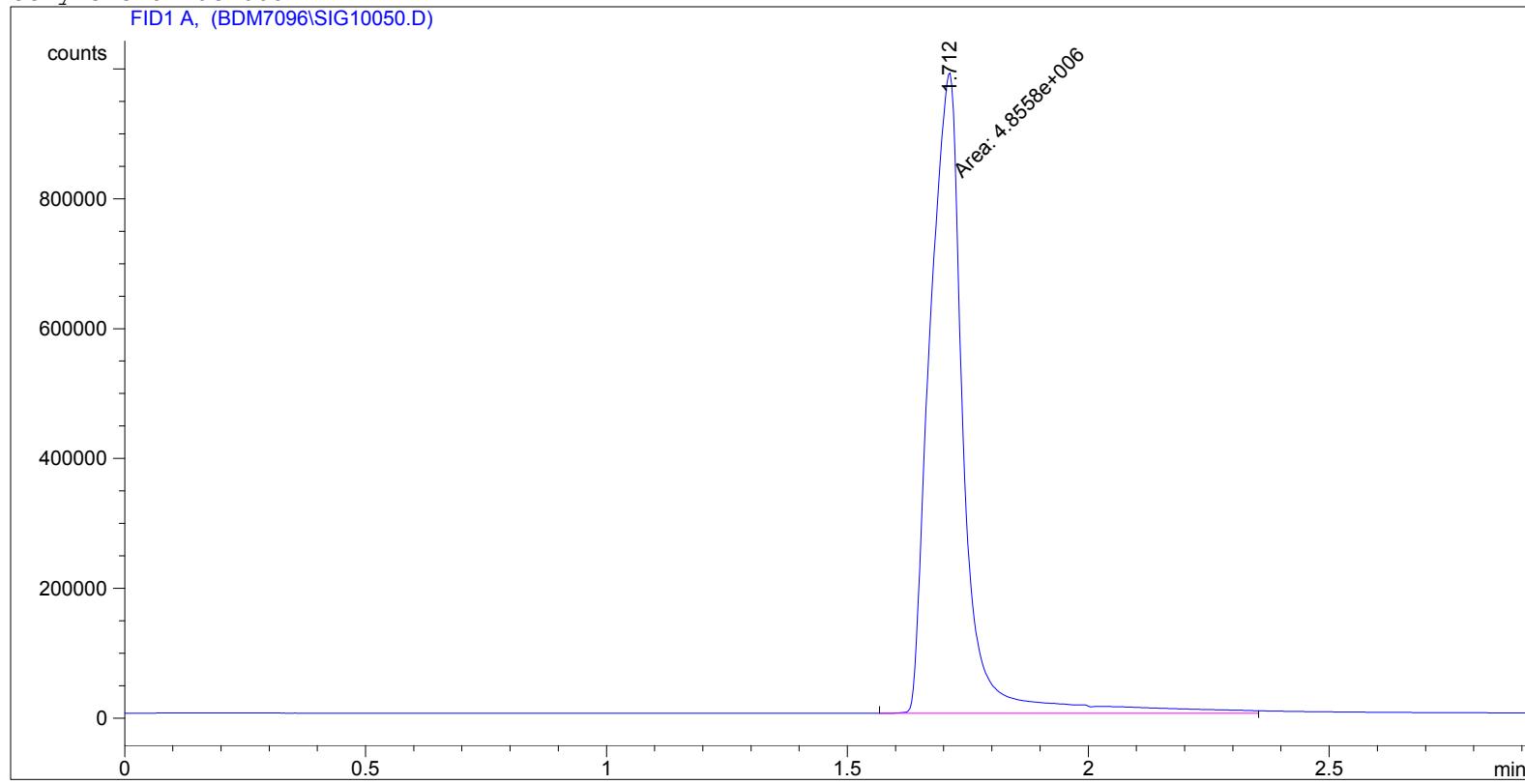
Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Post-Cal

Inlet Mid-Level Post Cal Inj 3 2611 ppm EO

```
=====
Injection Date : 7/12/2017 3:47:00 PM
Sample Name : Post Mid Cal I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.712	MF	0.0819	4.85580e6	9.88495e5	1.000e2

Totals : 4.85580e6 9.88495e5

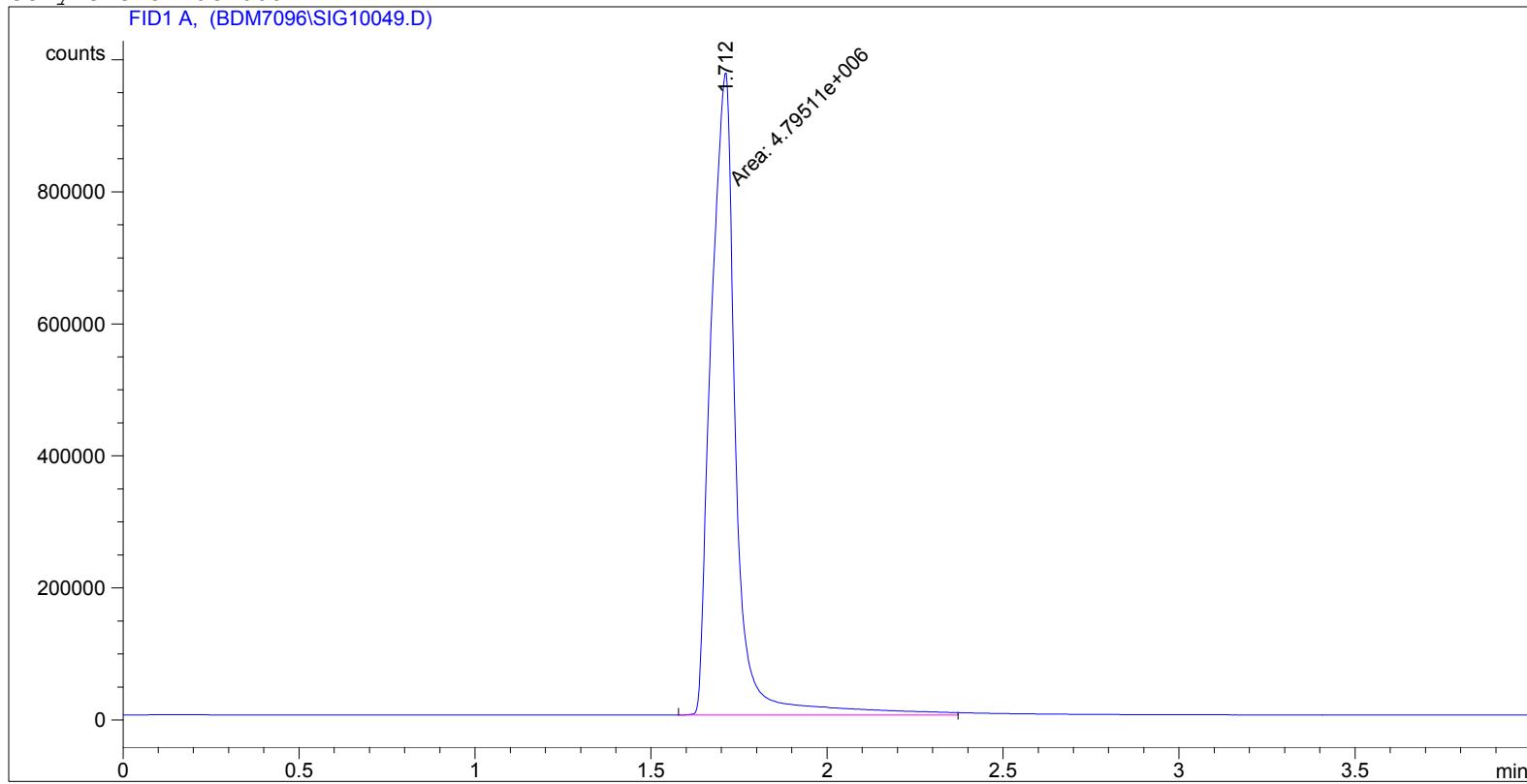
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid-Level Post Cal Inj 2 2611 ppm EO

```
=====
Injection Date : 7/12/2017 3:39:40 PM
Sample Name : Post Mid Cal I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.712	MF	0.0819	4.79511e6	9.75400e5	1.000e2

Totals : 4.79511e6 9.75400e5

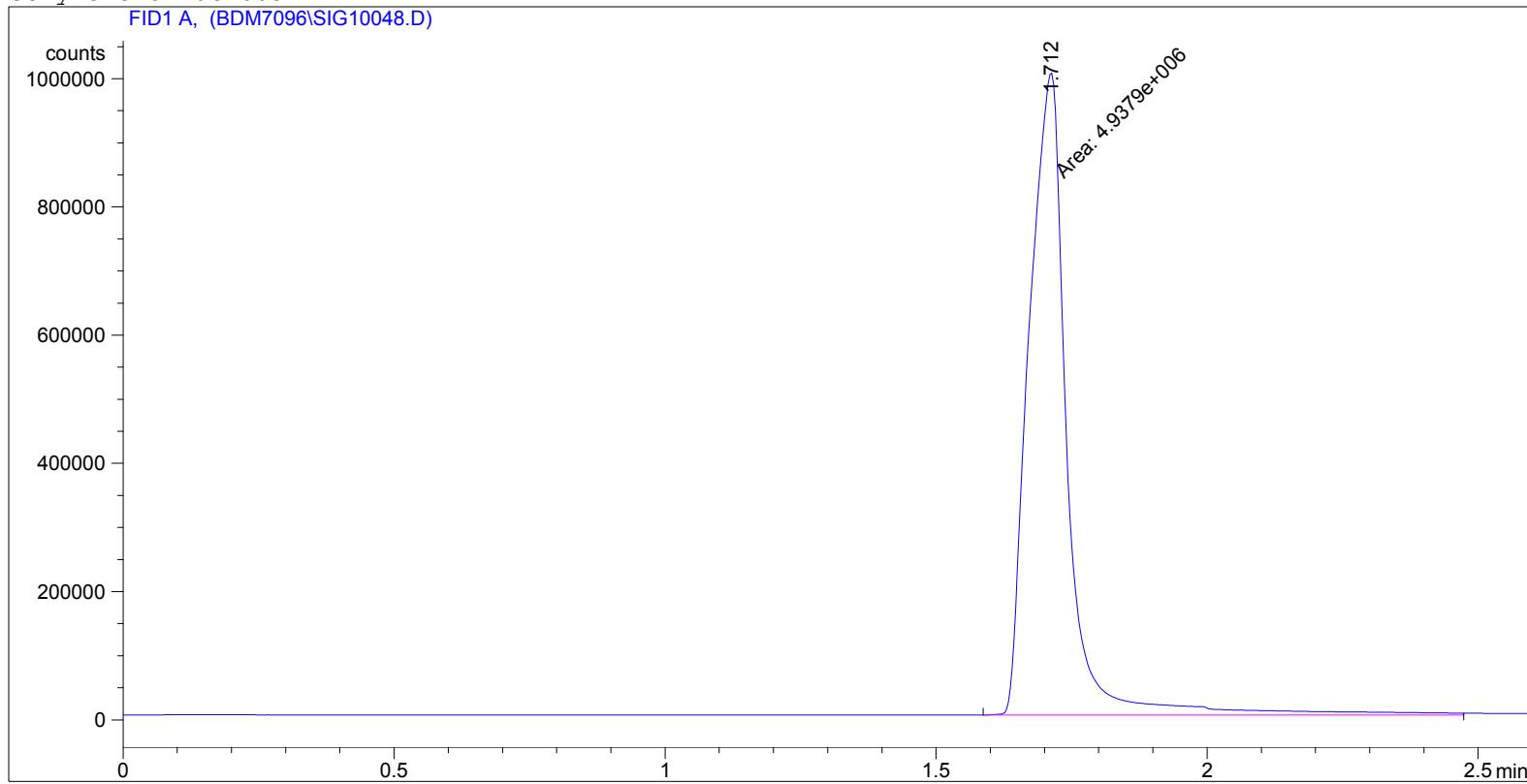
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid-Level Post Cal Inj 1 2611 ppm EO

```
=====
Injection Date : 7/12/2017 3:30:57 PM
Sample Name : Post Mid Cal II
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.712	MM	0.0820	4.93790e6	1.00344e6	1.000e2

Totals : 4.93790e6 1.00344e6

Results obtained with enhanced integrator!

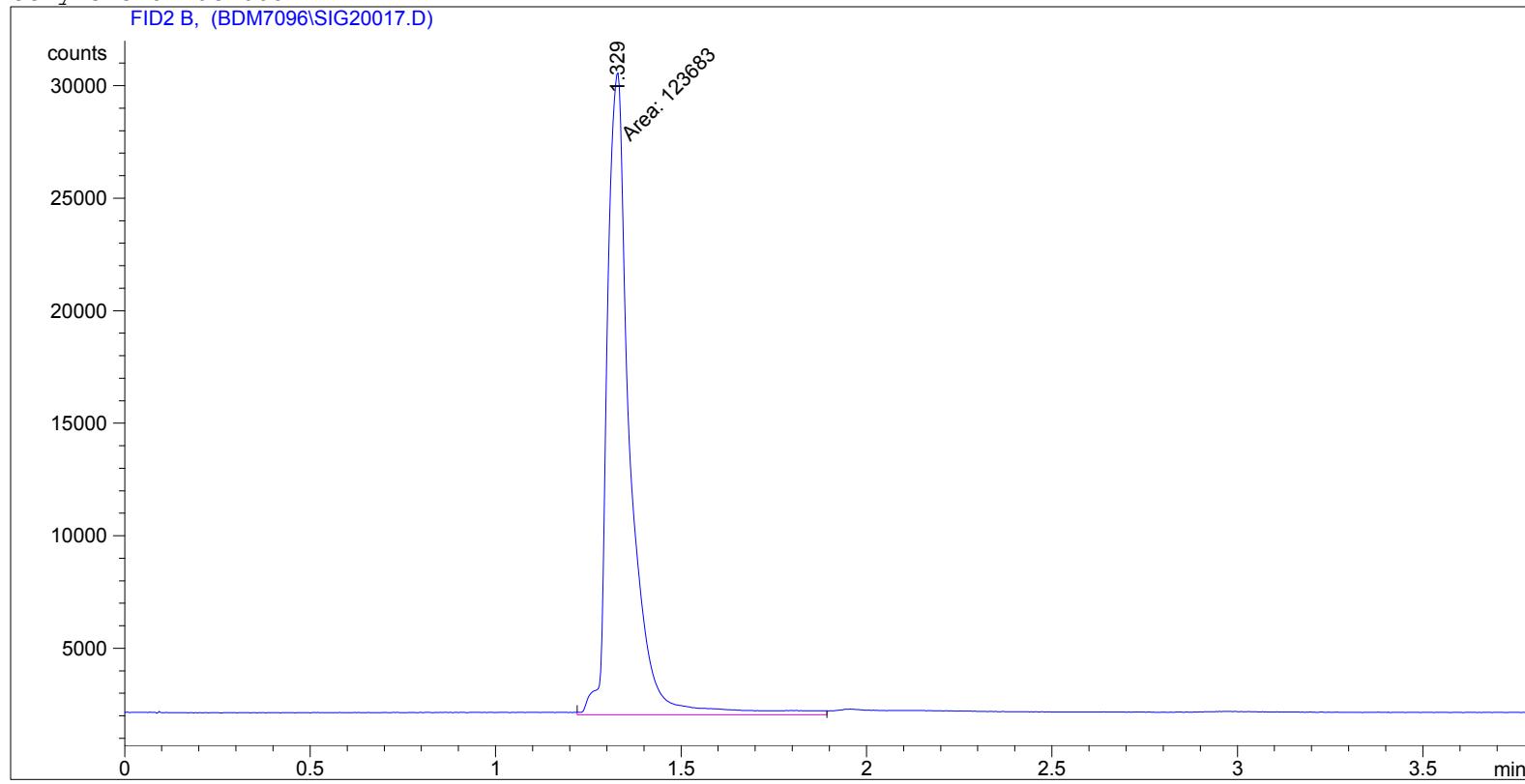
=====

*** End of Report ***

Outlet Pre-Cal

Lineloss Outlet 50 ppm Inj 3

```
=====
Injection Date : 7/11/2017 2:14:15 PM
Sample Name : Lineloss Out I3
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.329	MM	0.0721	1.23683e5	2.86044e4	1.000e2

Totals : 1.23683e5 2.86044e4

Results obtained with enhanced integrator!

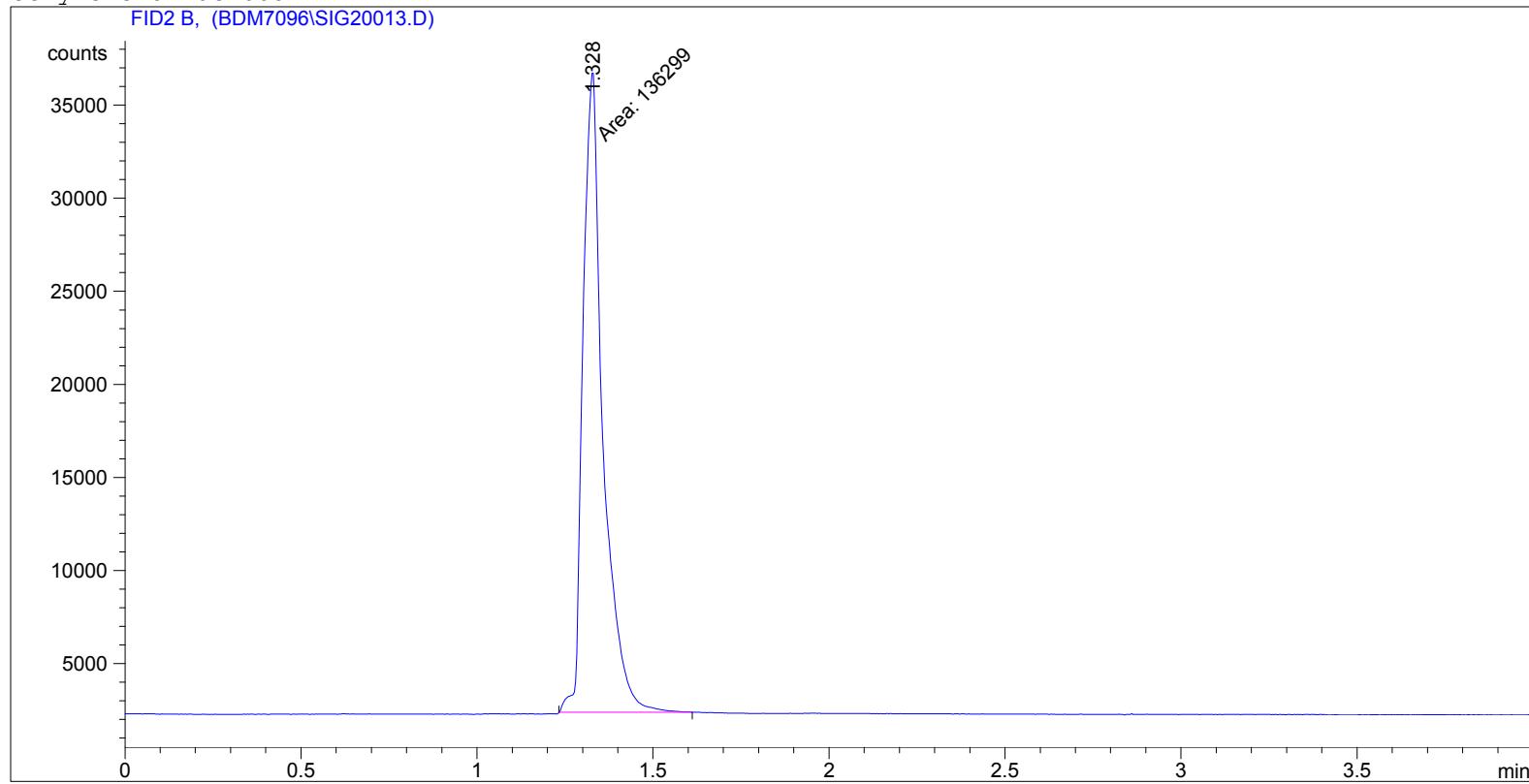
=====

*** End of Report ***

Lineloss Outlet 50 ppm Inj 2

=====

Injection Date : 7/11/2017 1:38:15 PM
Sample Name : Lineloss Out I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.328	MM	0.0659	1.36299e5	3.44839e4	1.000e2

Totals : 1.36299e5 3.44839e4

Results obtained with enhanced integrator!

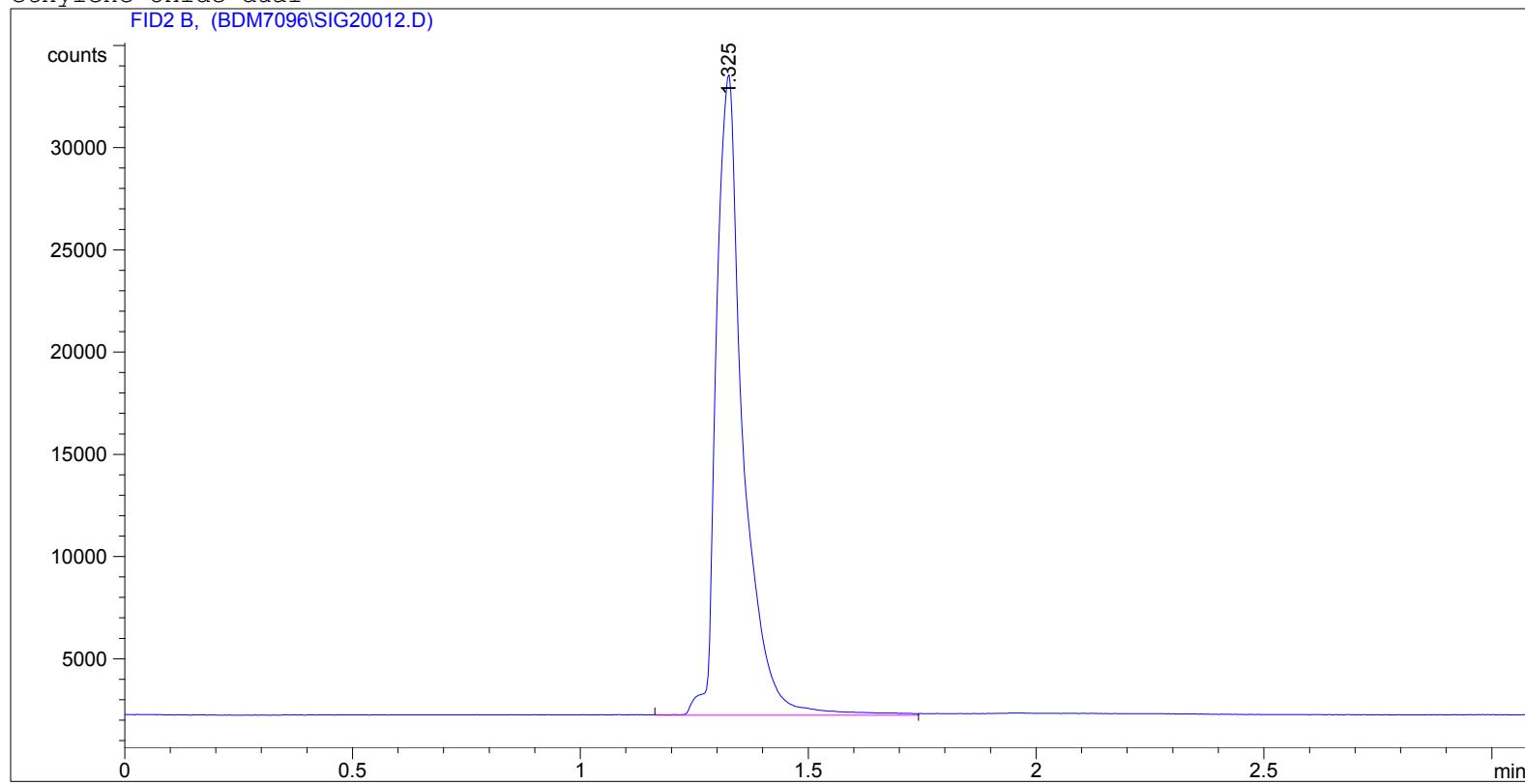
=====

*** End of Report ***

Lineloss Outlet 50 ppm Inj 1

=====

Injection Date : 7/11/2017 1:22:54 PM
Sample Name : Lineloss Out II Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.325	BV	0.0617	1.28445e5	3.14004e4	1.000e2

Totals : 1.28445e5 3.14004e4

Results obtained with enhanced integrator!

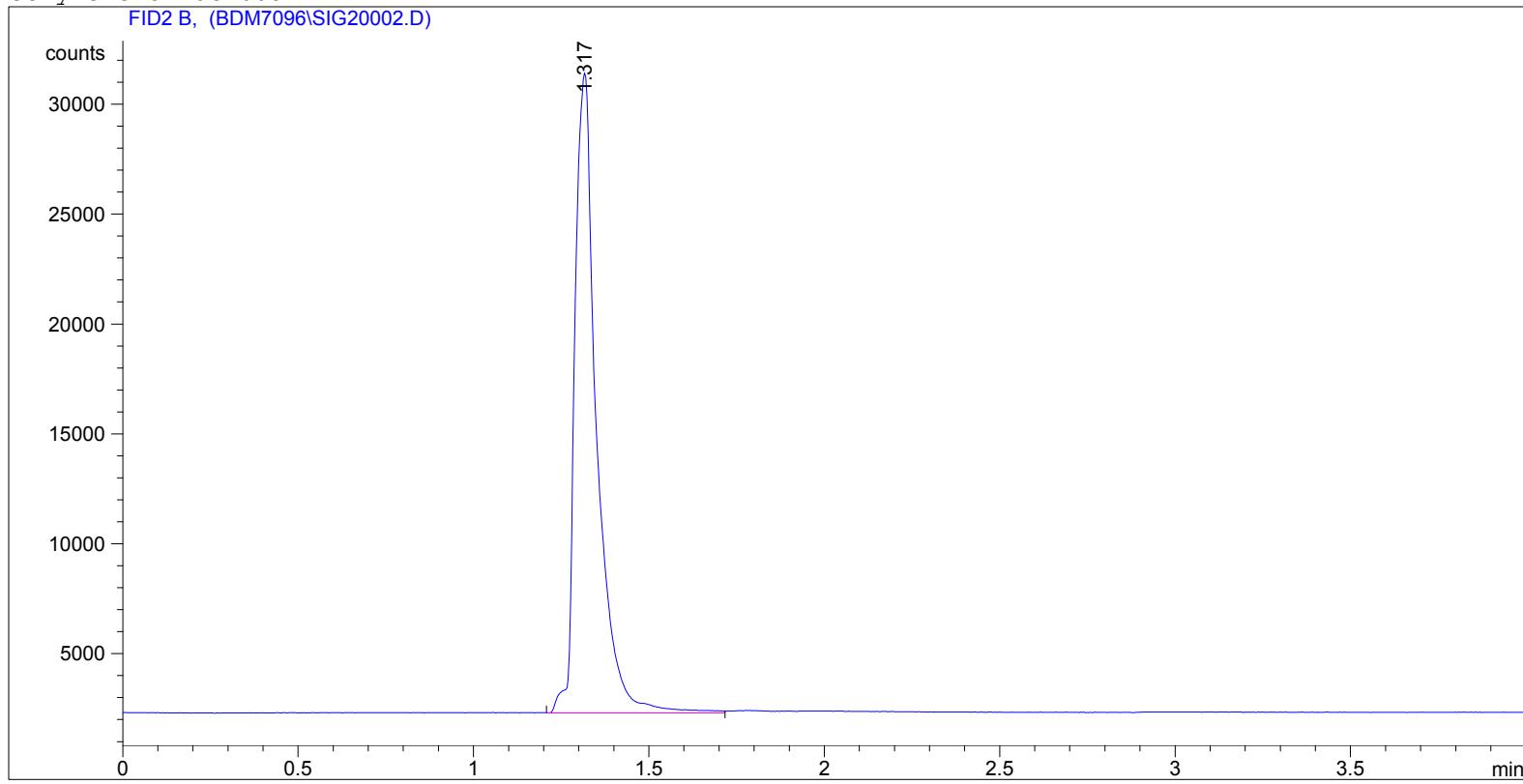
=====

*** End of Report ***

50 ppm EO Inj 3

=====

Injection Date : 7/11/2017 11:16:50 AM
Sample Name : 50 ppm EO I3 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.317	VV	0.0657	1.26555e5	2.91216e4	1.000e2

Totals : 1.26555e5 2.91216e4

Results obtained with enhanced integrator!

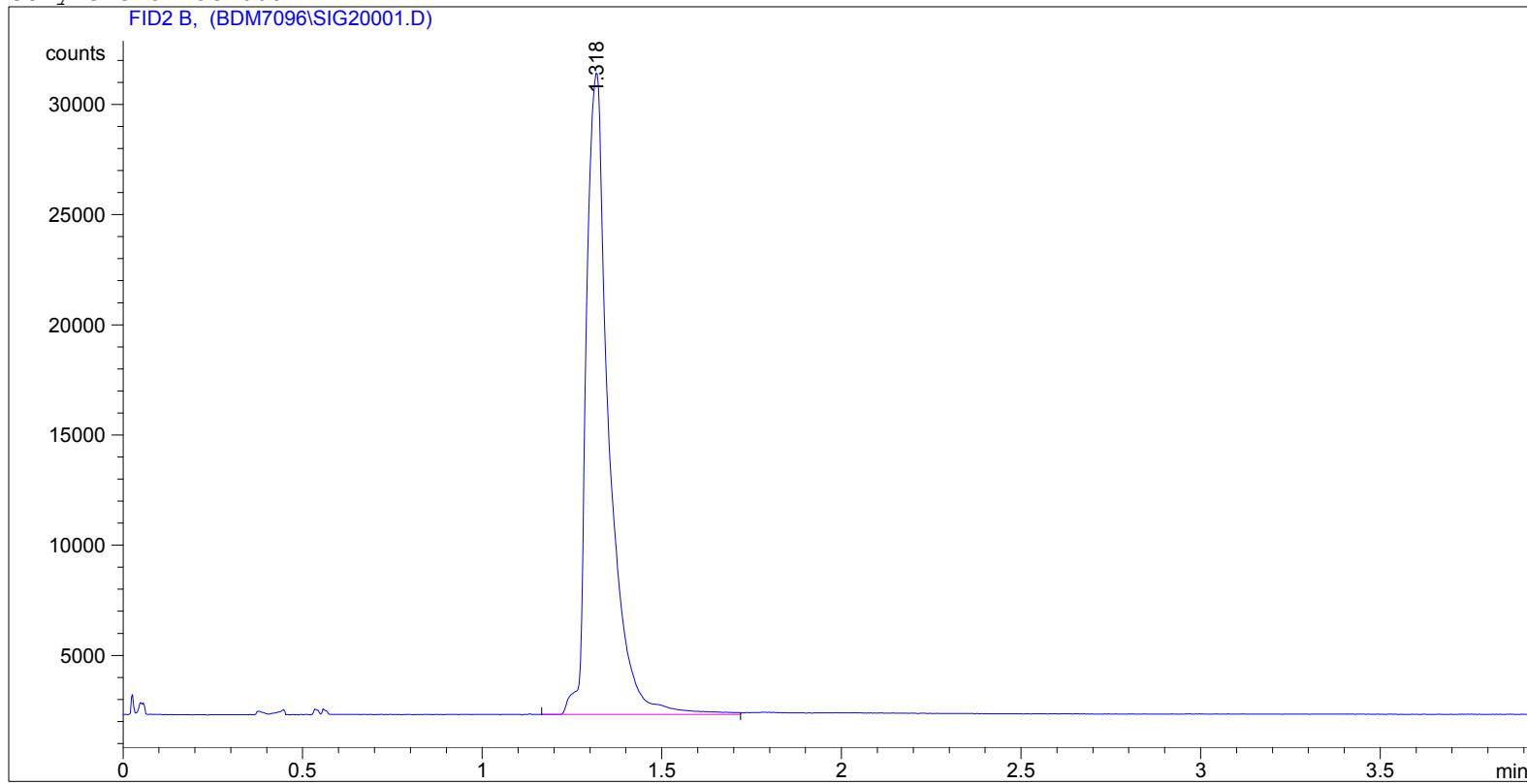
=====

*** End of Report ***

50 ppm EO Inj 2

=====

Injection Date : 7/11/2017 11:09:48 AM
Sample Name : 50 ppm EO I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.318	VV	0.0652	1.27810e5	2.91283e4	1.000e2

Totals : 1.27810e5 2.91283e4

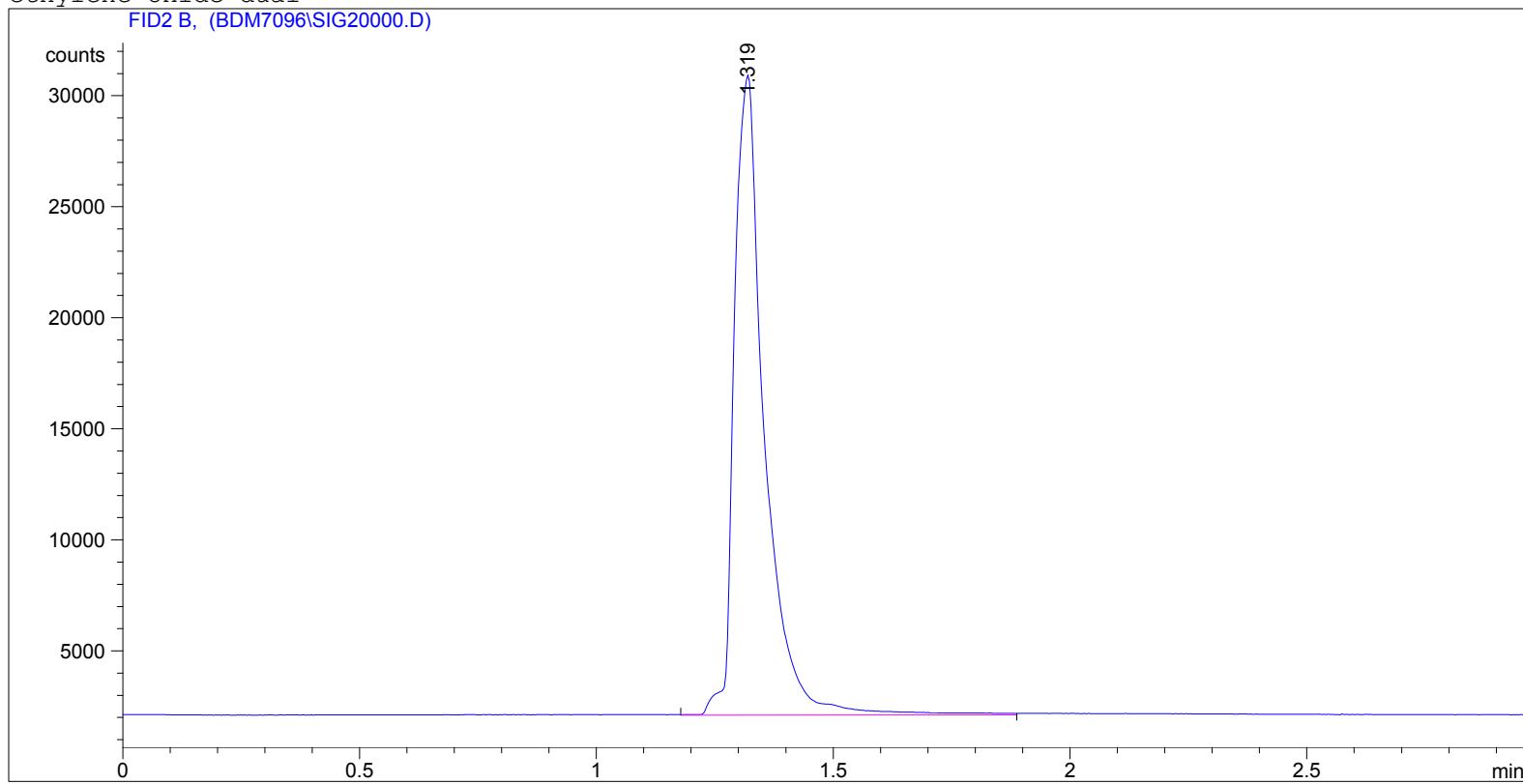
Results obtained with enhanced integrator!

=====

*** End of Report ***

50 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 10:52:12 AM
Sample Name : 50 ppm EO I1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.319	VV	0.0672	1.29071e5	2.88352e4	1.000e2

Totals : 1.29071e5 2.88352e4

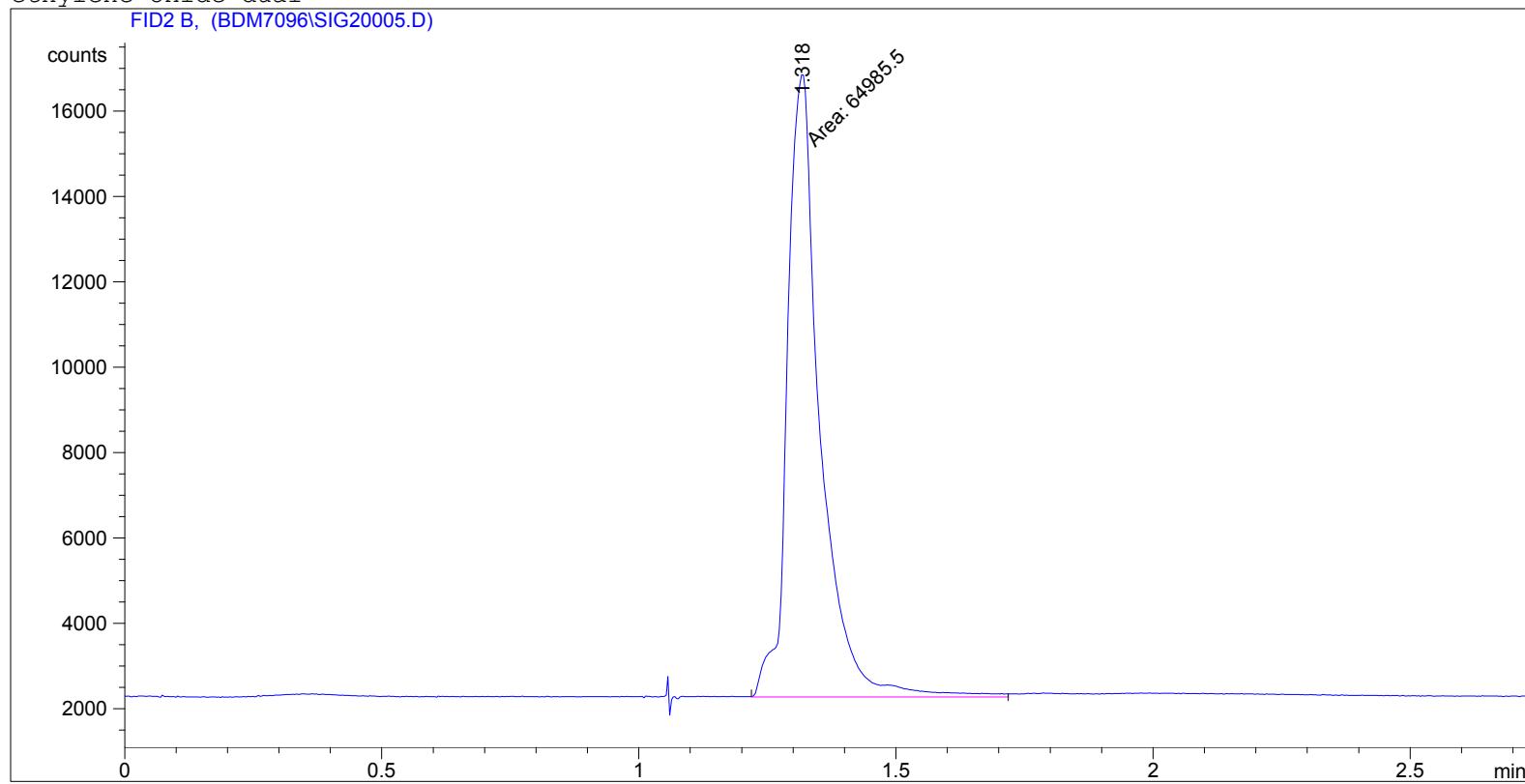
Results obtained with enhanced integrator!

=====

*** End of Report ***

25 ppm EO Inj 3

```
=====
Injection Date : 7/11/2017 11:59:57 AM
Sample Name : 25 ppm EO I3
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.318	MM	0.0742	6.49855e4	1.46020e4	1.000e2

Totals : 6.49855e4 1.46020e4

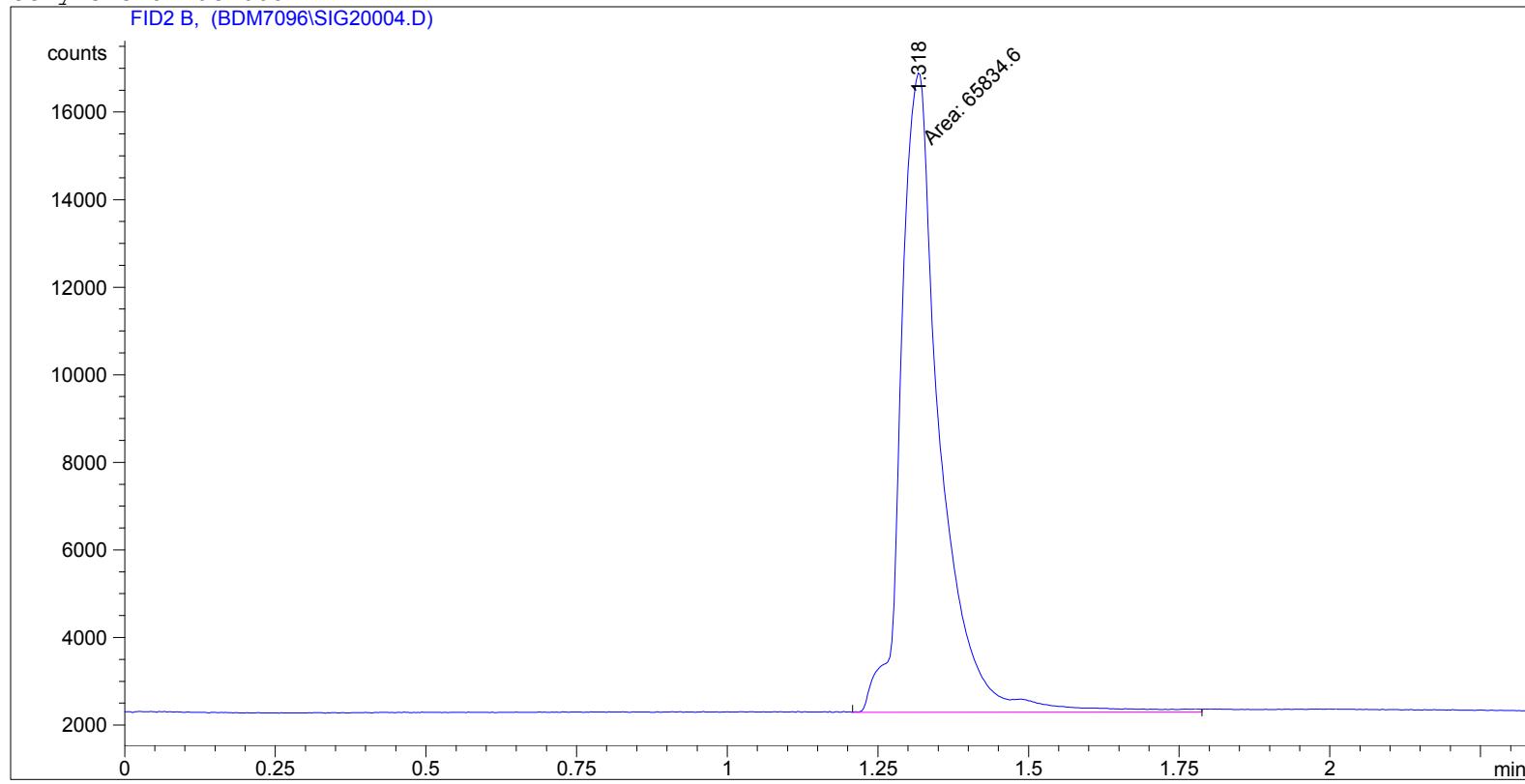
Results obtained with enhanced integrator!

=====

*** End of Report ***

25 ppm EO Inj 2

```
=====
Injection Date : 7/11/2017 11:54:45 AM
Sample Name : 25 ppm EO I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.318	MM	0.0750	6.58346e4	1.46250e4	1.000e2

Totals : 6.58346e4 1.46250e4

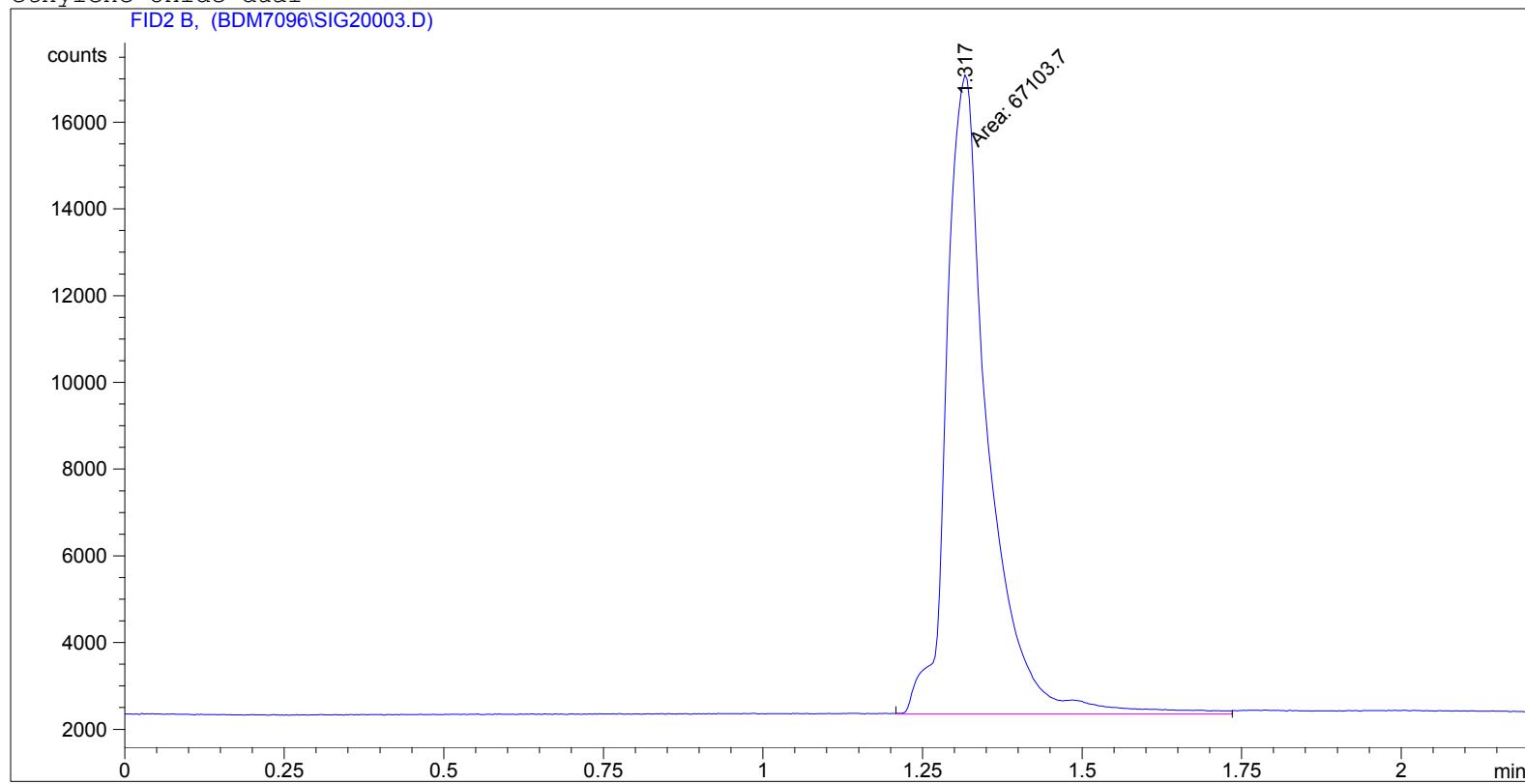
Results obtained with enhanced integrator!

=====

*** End of Report ***

25 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 11:32:45 AM
Sample Name : 25 ppm EO I1
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.317	MM	0.0758	6.71037e4	1.47479e4	1.000e2

Totals : 6.71037e4 1.47479e4

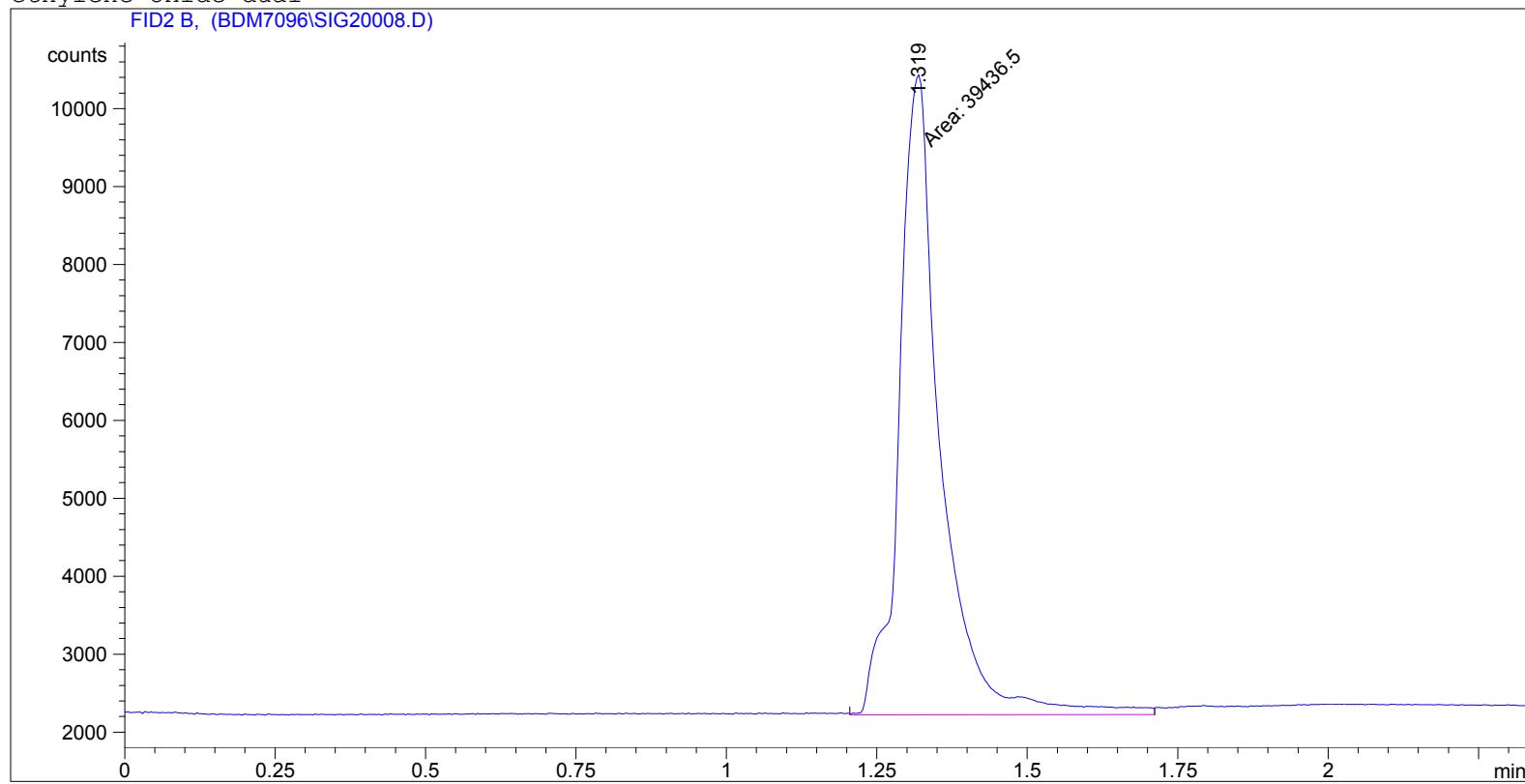
Results obtained with enhanced integrator!

=====

*** End of Report ***

12.5 ppm EO Inj 3

```
=====
Injection Date : 7/11/2017 12:23:58 PM
Sample Name : 12.5 ppm EO I3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.319	MM	0.0799	3.94365e4	8223.23340	1.000e2

Totals : 3.94365e4 8223.23340

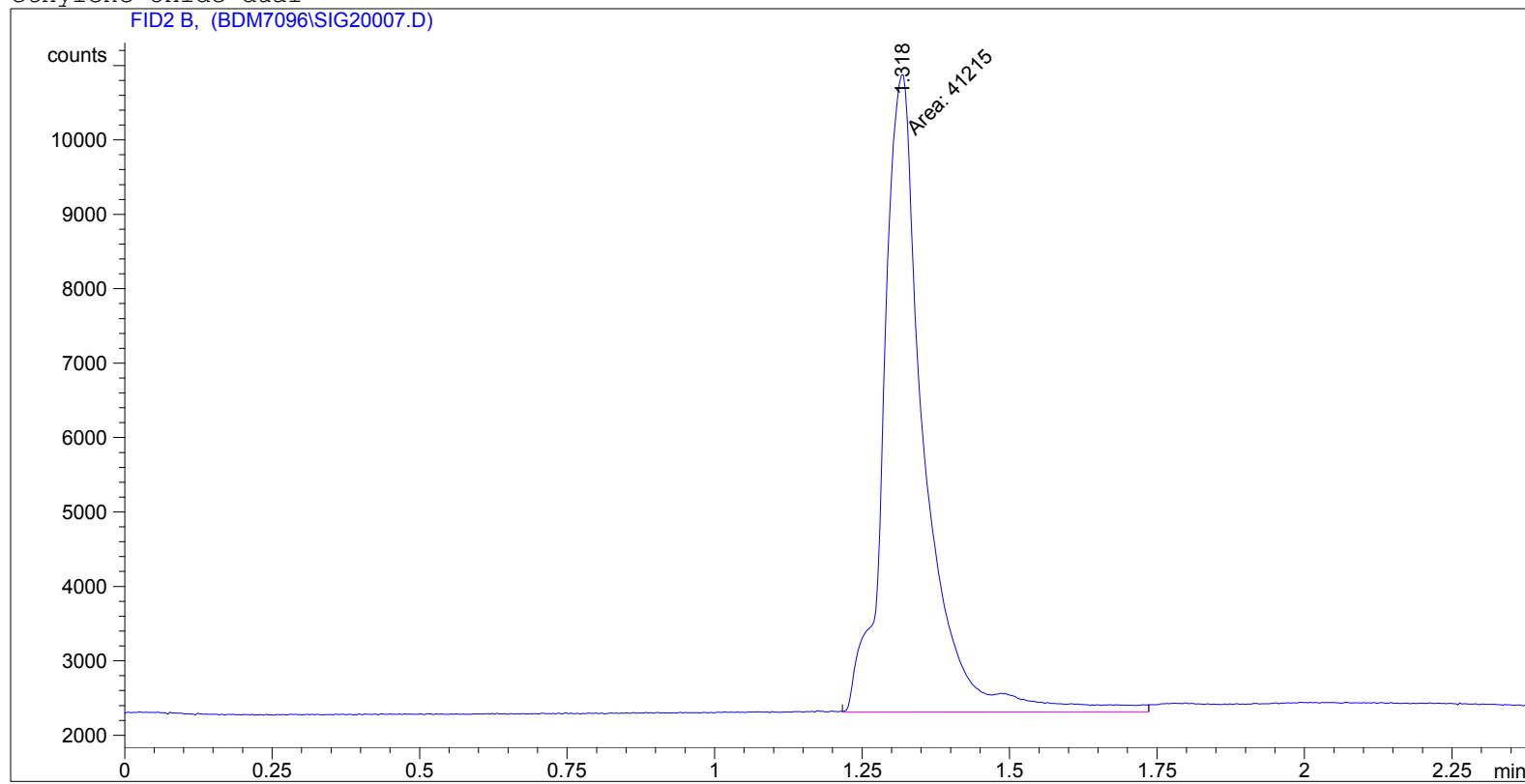
Results obtained with enhanced integrator!

=====

*** End of Report ***

12.5 ppm EO Inj 2

```
=====
Injection Date : 7/11/2017 12:17:54 PM
Sample Name : 12.5 ppm EO I2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.318	MM	0.0799	4.12150e4	8592.58008	1.000e2

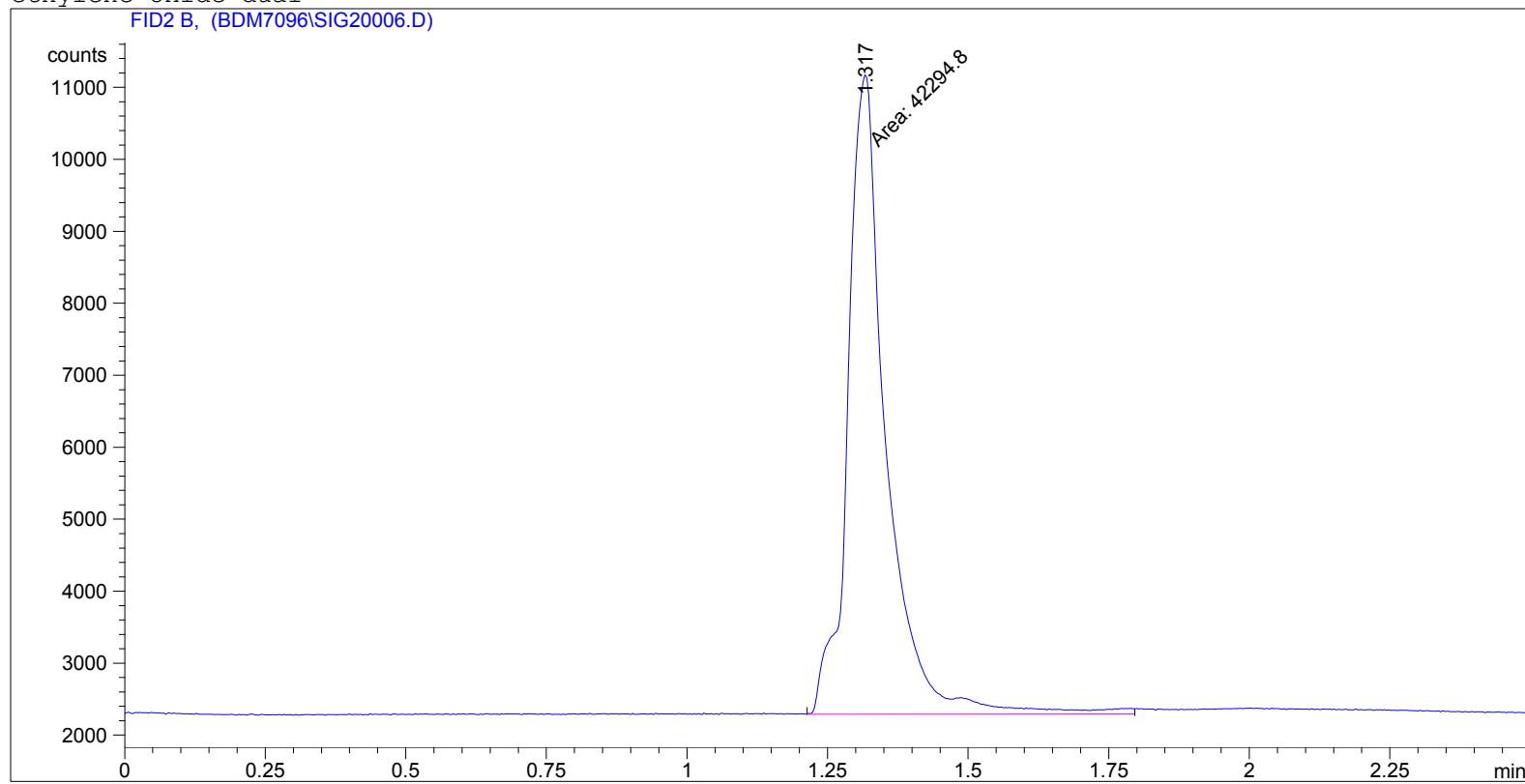
Totals : 4.12150e4 8592.58008

Results obtained with enhanced integrator!

=====
*** End of Report ***

12.5 ppm EO Inj 1

```
=====
Injection Date : 7/11/2017 12:06:25 PM
Sample Name : 12.5 ppm EO II
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 6/7/2017 5:20:13 PM by jwd
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.317	MM	0.0793	4.22948e4	8891.60645	1.000e2

Totals : 4.22948e4 8891.60645

Results obtained with enhanced integrator!

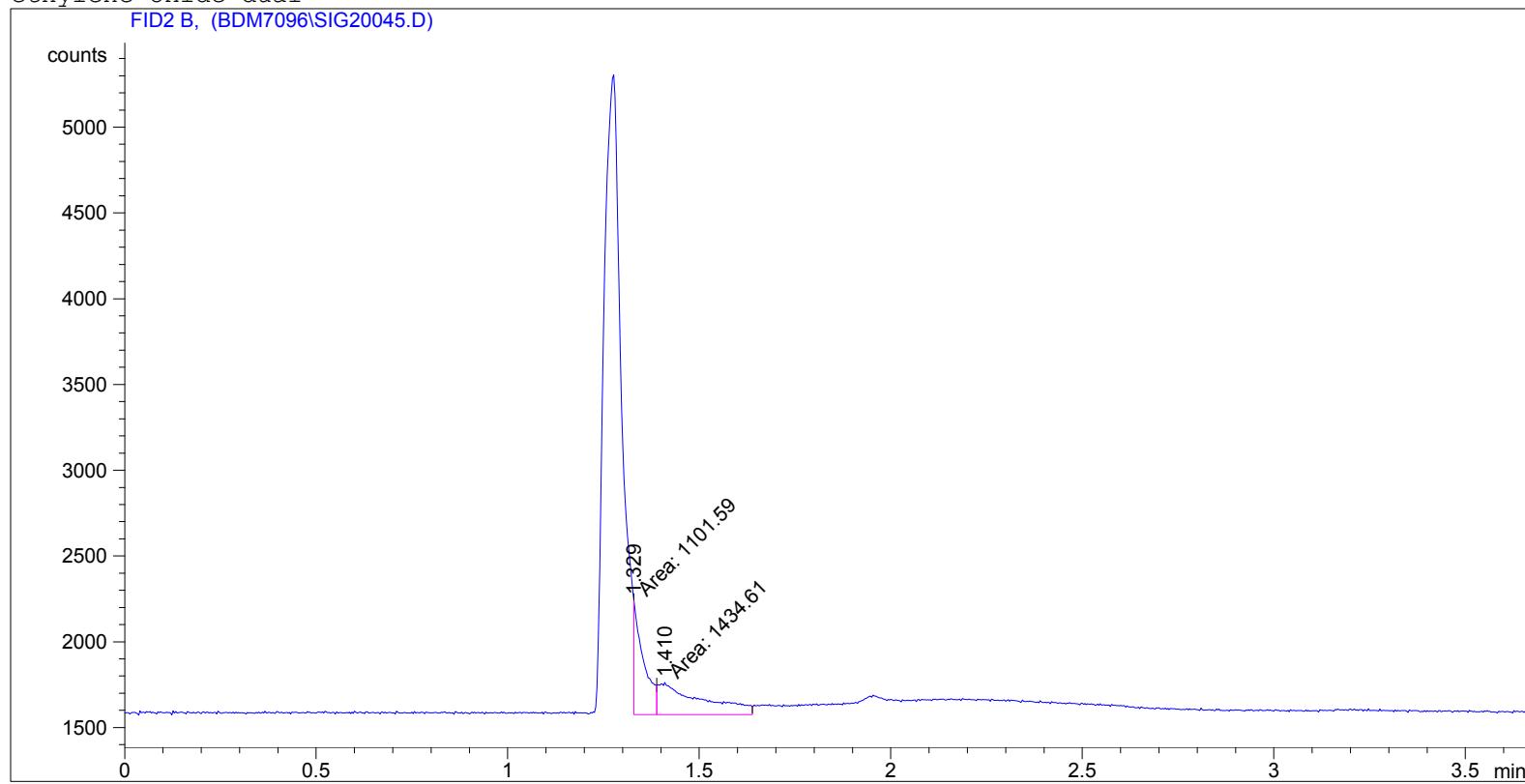
=====

*** End of Report ***

Outlet Runs

Outlet Run 3 Inj 5

=====
Injection Date : 7/12/2017 2:36:09 PM
Sample Name : Outlet Run 3 I5 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.329	FM	0.0225	1101.59351	665.46460	43.43472
2	1.410	FM	0.1279	1434.61157	186.88922	56.56528

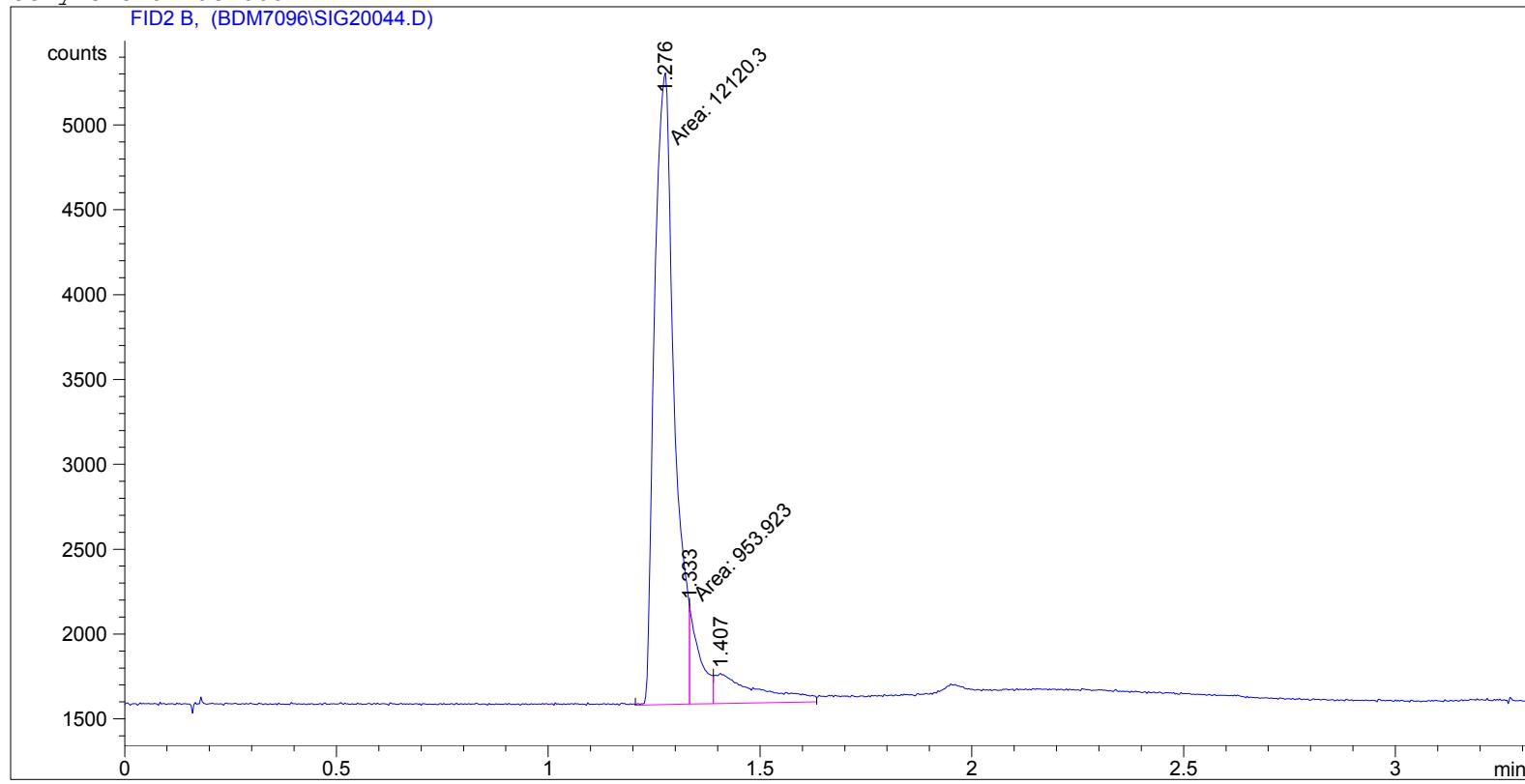
Totals : 2536.20508 852.35382

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 3 Inj 4

```
=====
Injection Date : 7/12/2017 2:26:52 PM
Sample Name : Outlet Run 3 I4
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.276	MF	0.0541	1.21203e4	3735.96948	84.76127
2	1.333	FM	0.0273	953.92303	583.00903	6.67110
3	1.407	VV	0.0851	1225.11328	178.45599	8.56763

Totals : 1.42993e4 4497.43451

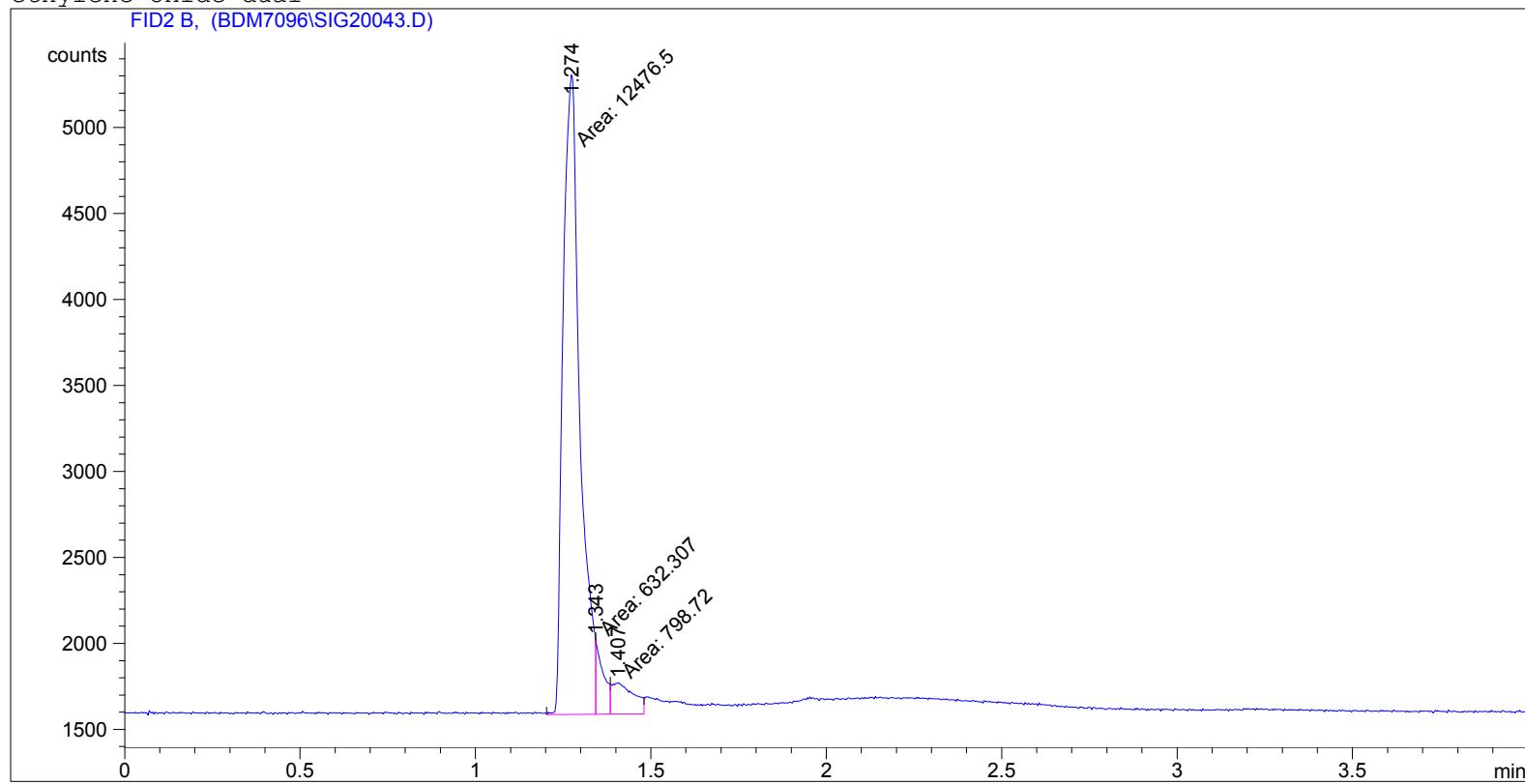
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 3 Inj 3

```
=====
Injection Date : 7/12/2017 2:14:05 PM
Sample Name : Outlet Run 3 I3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.274	MF	0.0558	1.24765e4	3727.65454	89.71039
2	1.343	FM	0.0244	632.30731	432.58929	4.54652
3	1.407	FM	0.0740	798.72028	179.94623	5.74309

Totals : 1.39075e4 4340.19006

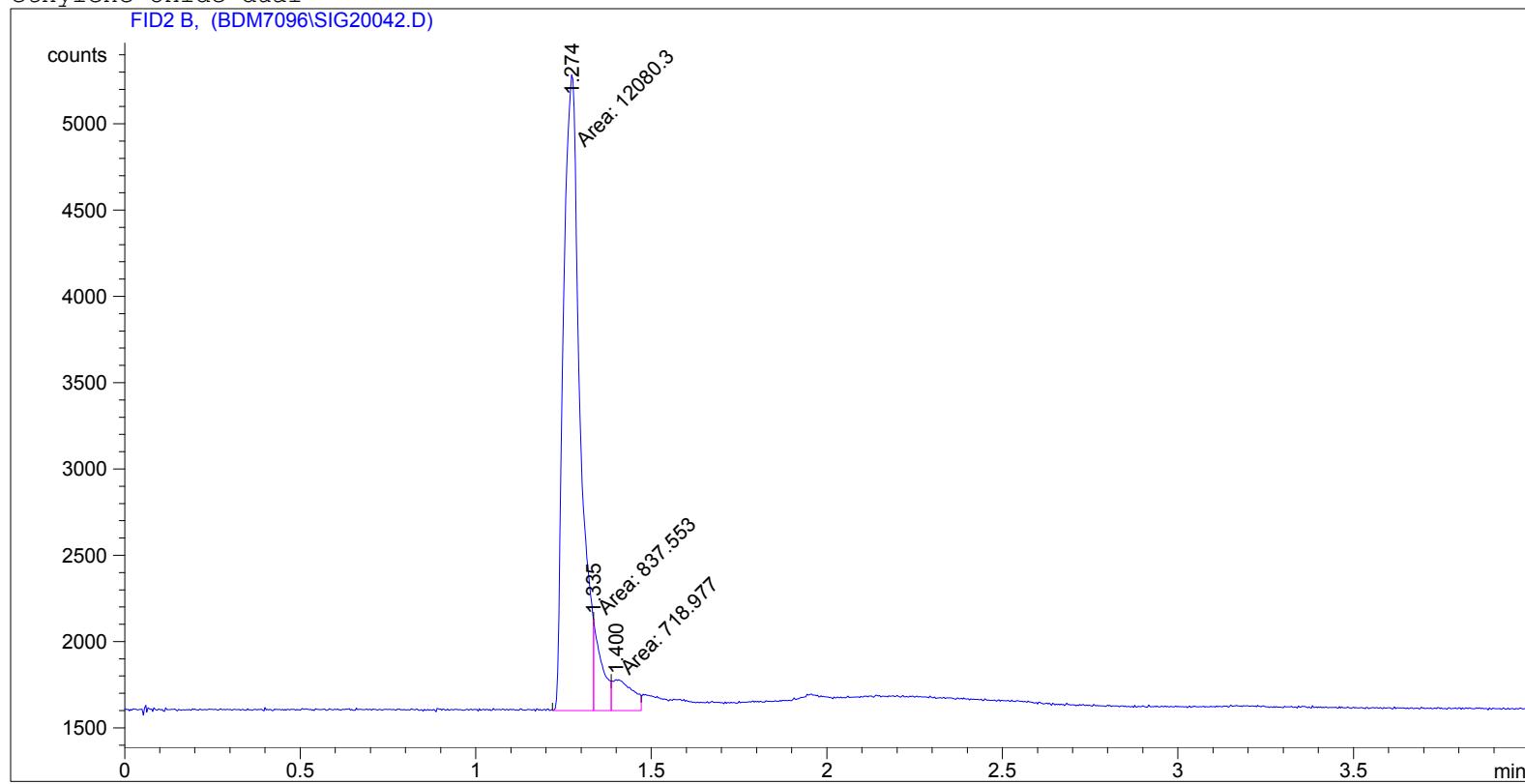
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 3 Inj 2

```
=====
Injection Date : 7/12/2017 2:00:57 PM
Sample Name : Outlet Run 3 I2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.274	MF	0.0546	1.20803e4	3690.42114	88.58586
2	1.335	FM	0.0264	837.55304	528.05634	6.14184
3	1.400	MF	0.0666	718.97705	179.93945	5.27231

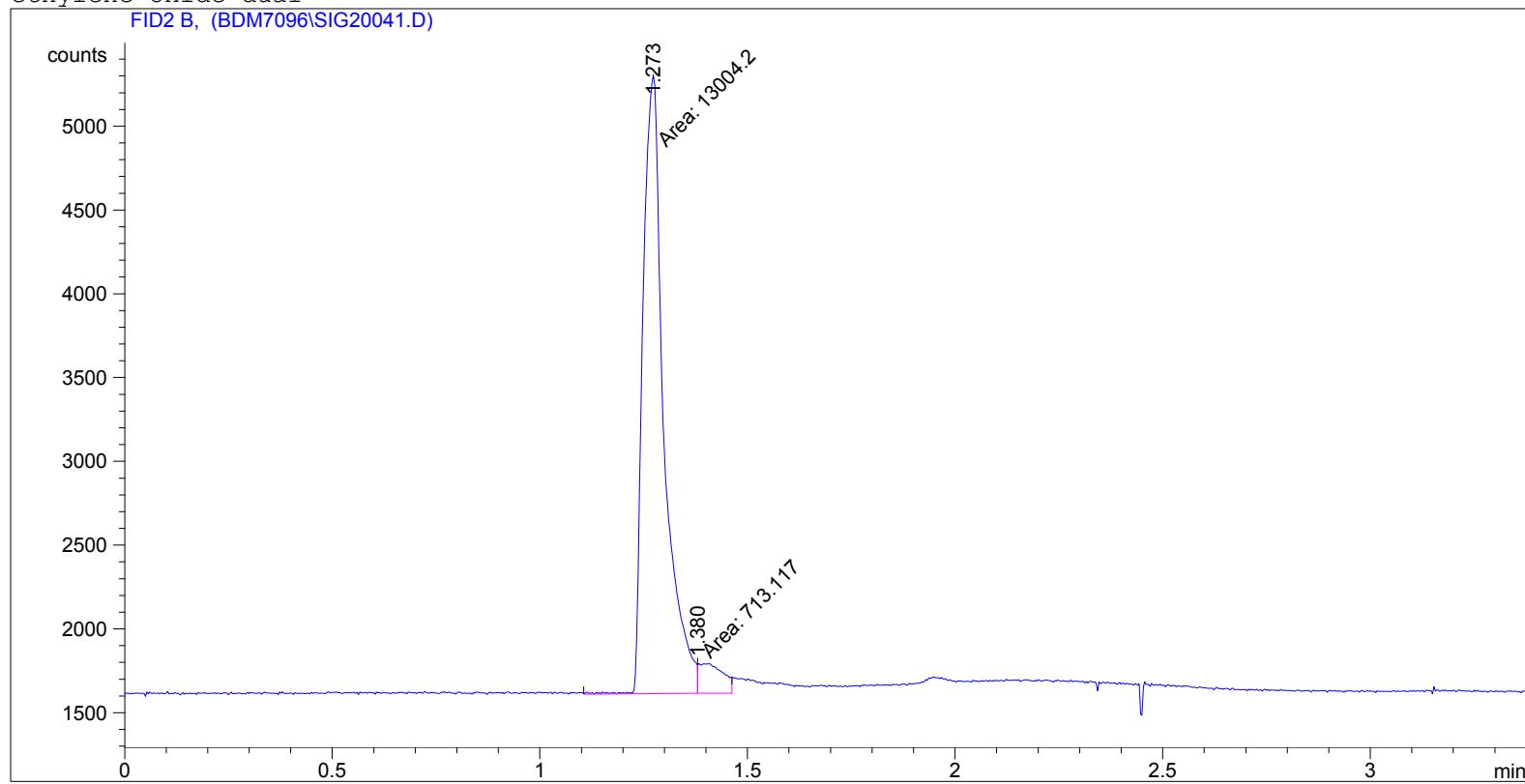
Totals : 1.36369e4 4398.41693

Results obtained with enhanced integrator!

===== *** End of Report ***

Outlet Run 3 Inj 1

```
=====
Injection Date : 7/12/2017 1:48:43 PM
Sample Name : Outlet Run 3 II
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.273	MF	0.0586	1.30042e4	3697.61548	94.80134
2	1.380	FM	0.0637	713.11658	186.47653	5.19866

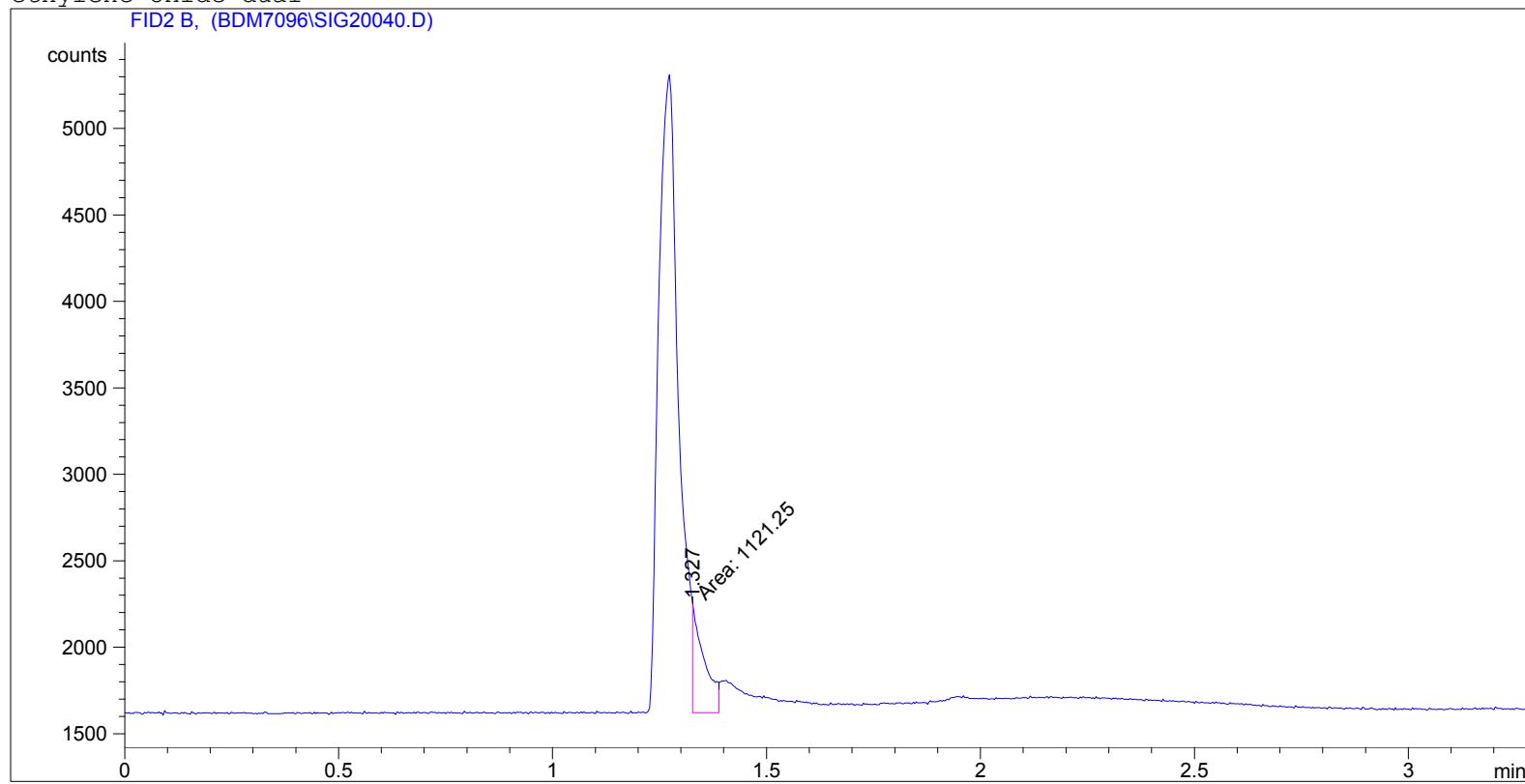
Totals : 1.37173e4 3884.09201

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 2 Inj 4

=====
Injection Date : 7/12/2017 1:34:29 PM
Sample Name : Outlet Run 2 I4 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.327	FM	0.0297	1121.25439	628.67493	1.000e2

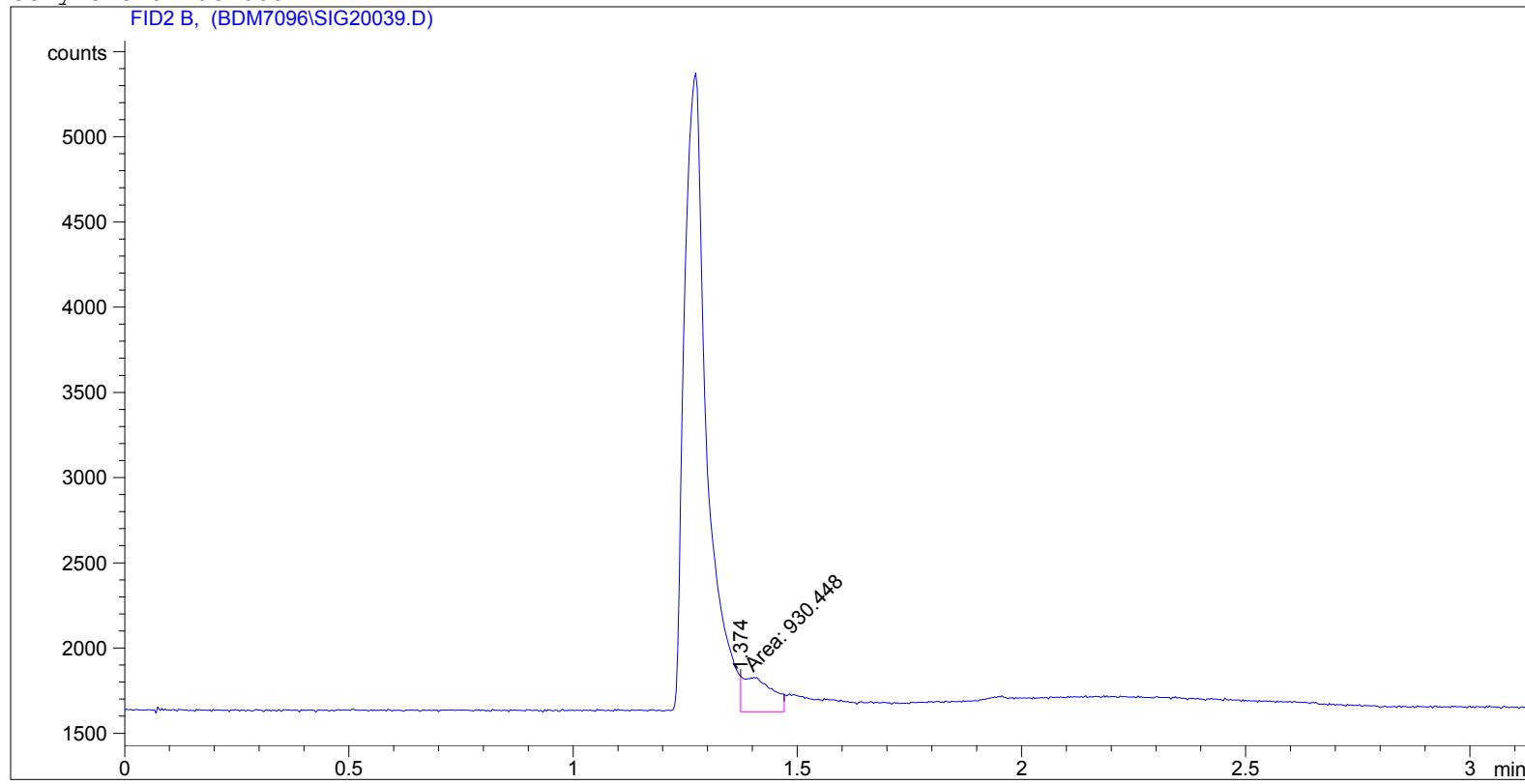
Totals : 1121.25439 628.67493

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 2 Inj 4

```
=====
Injection Date : 7/12/2017 1:21:38 PM
Sample Name : Outlet Run 2 I4
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.374	MF	0.0552	930.44830	208.69983	1.000e2

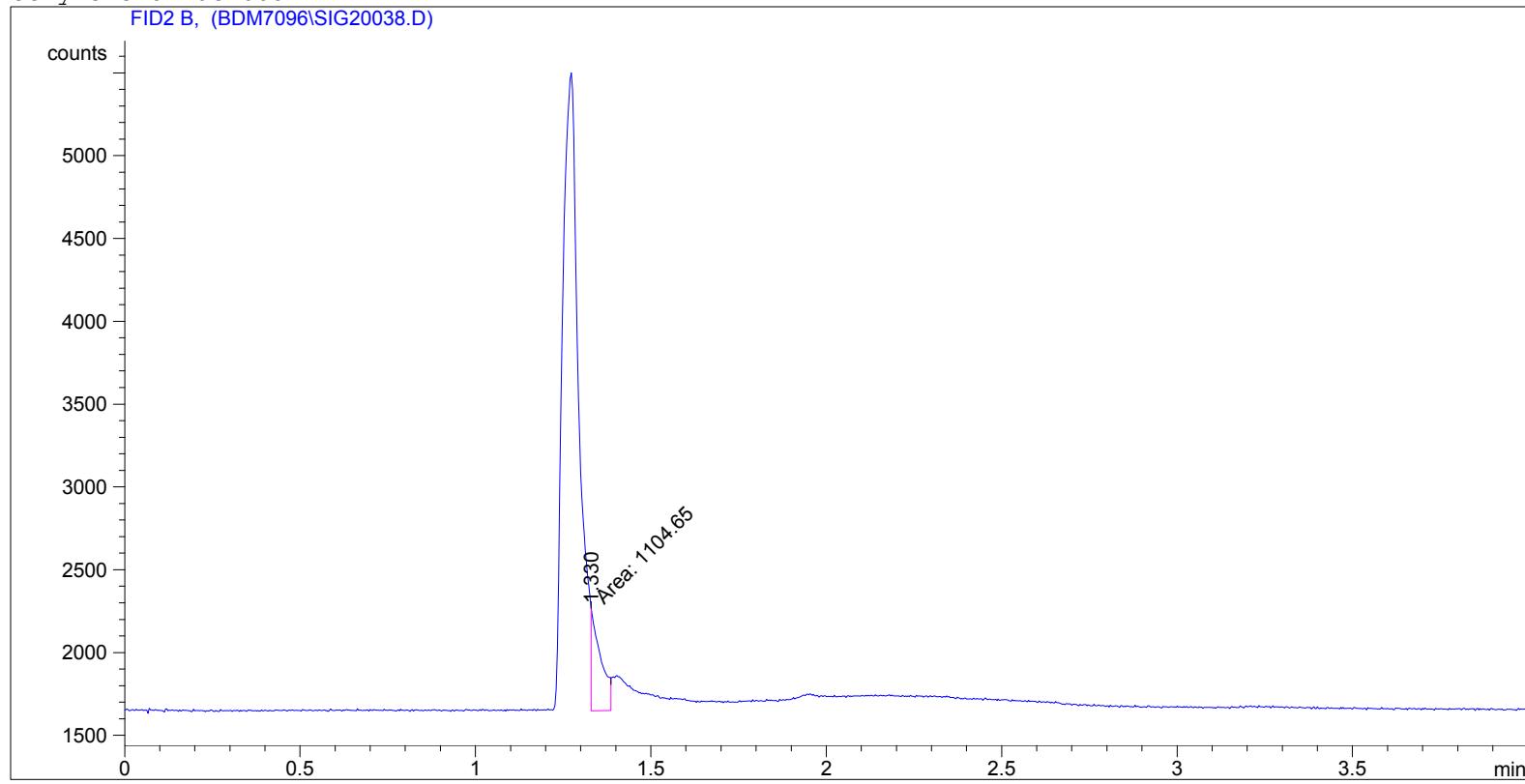
Totals : 930.44830 208.69983

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 2 Inj 3

```
=====
Injection Date : 7/12/2017 1:09:52 PM
Sample Name : Outlet Run 2 I3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.330	FM	0.0299	1104.64722	616.67358	1.000e2

Totals : 1104.64722 616.67358

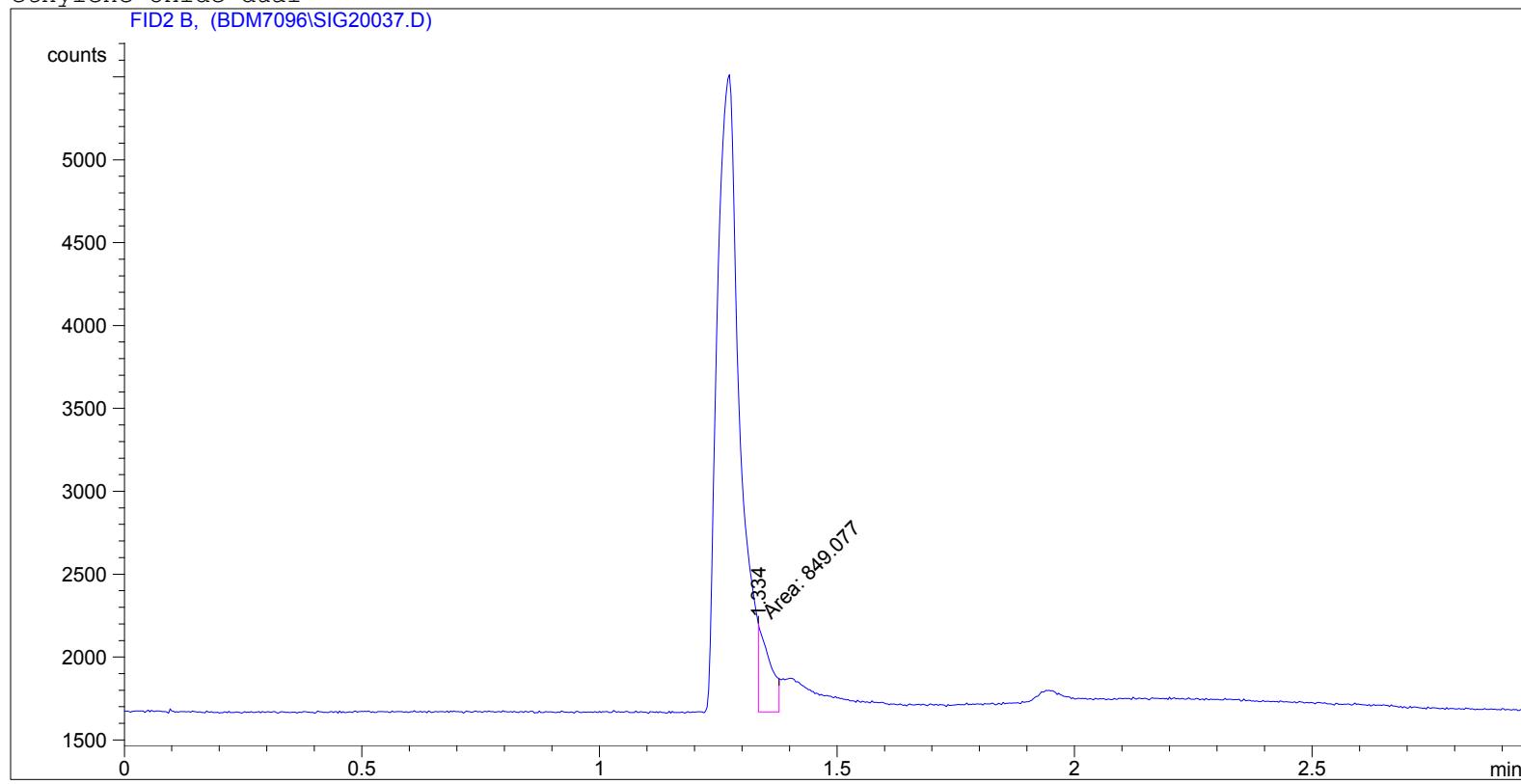
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 2 Inj 2

=====
Injection Date : 7/12/2017 12:56:39 PM
Sample Name : Outlet Run 2 I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.334	MM	0.0264	849.07745	536.25677	1.000e2

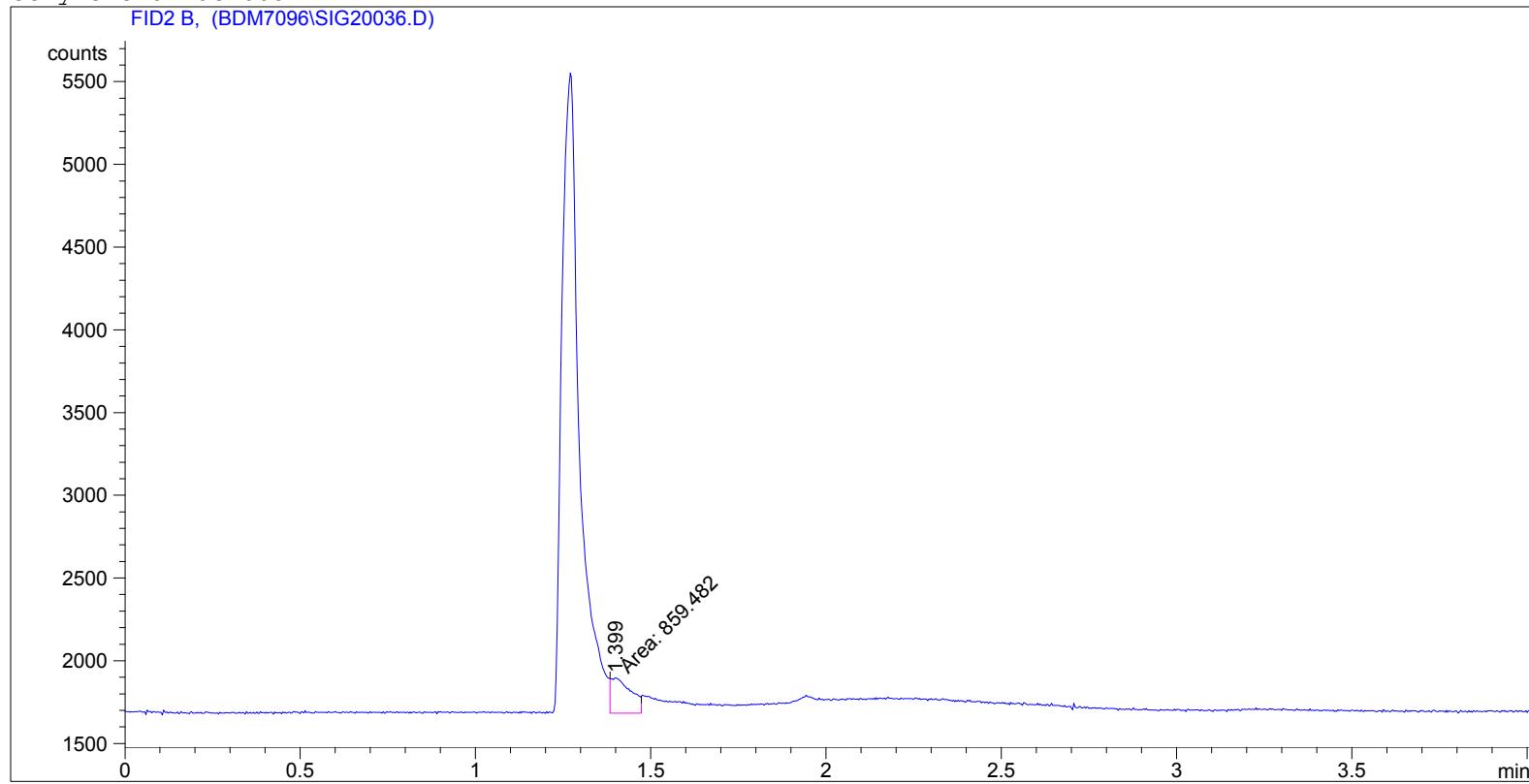
Totals : 849.07745 536.25677

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 2 Inj 1

=====
Injection Date : 7/12/2017 12:41:53 PM
Sample Name : Outlet Run 2 II Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.399	MF	0.0666	859.48242	214.96744	1.000e2

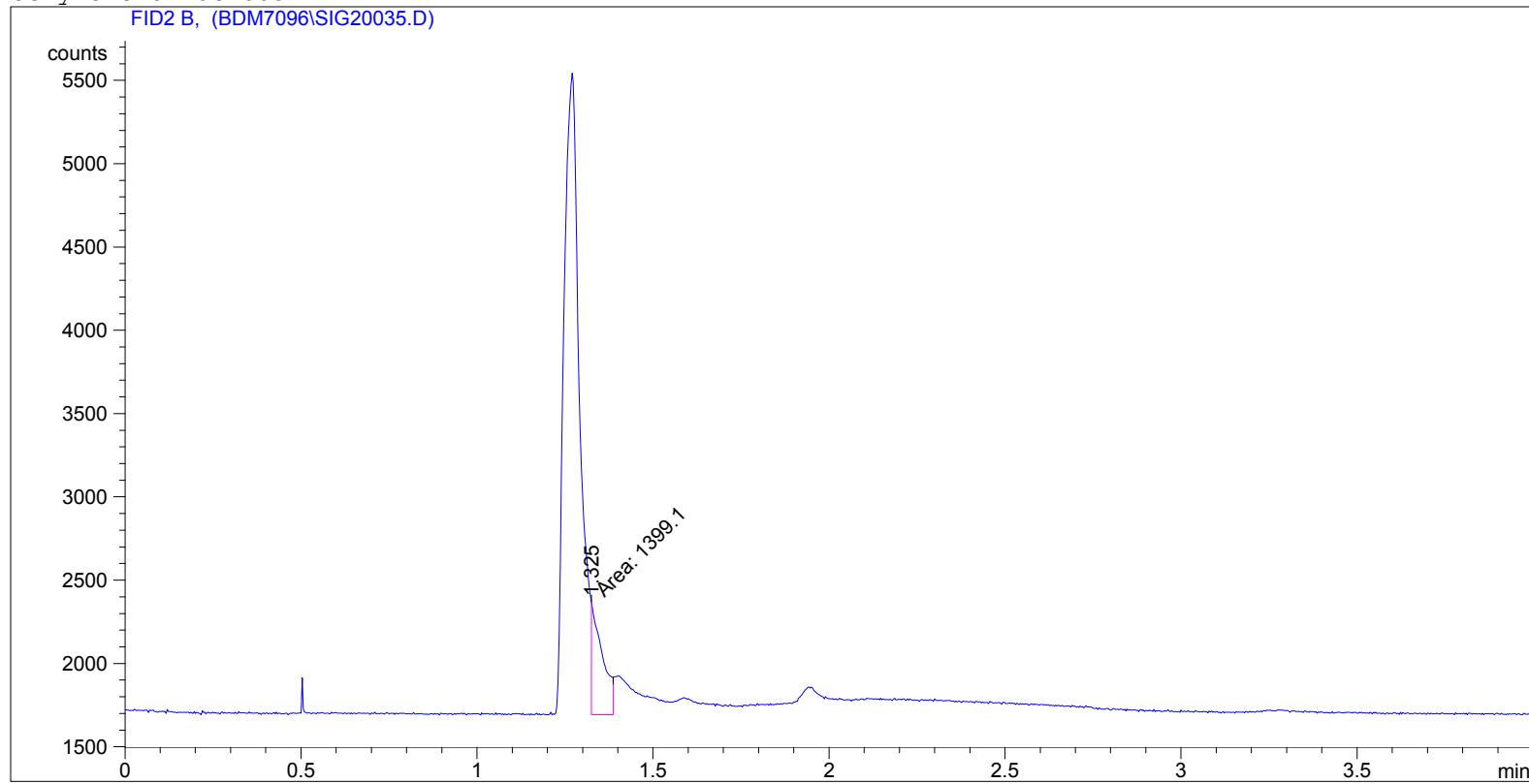
Totals : 859.48242 214.96744

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 1 Inj 6 Extra

```
=====
Injection Date : 7/12/2017 12:26:47 PM
Sample Name : Outlet Run 1 I6
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.325	FM	0.0343	1399.10132	680.48322	1.000e2

Totals : 1399.10132 680.48322

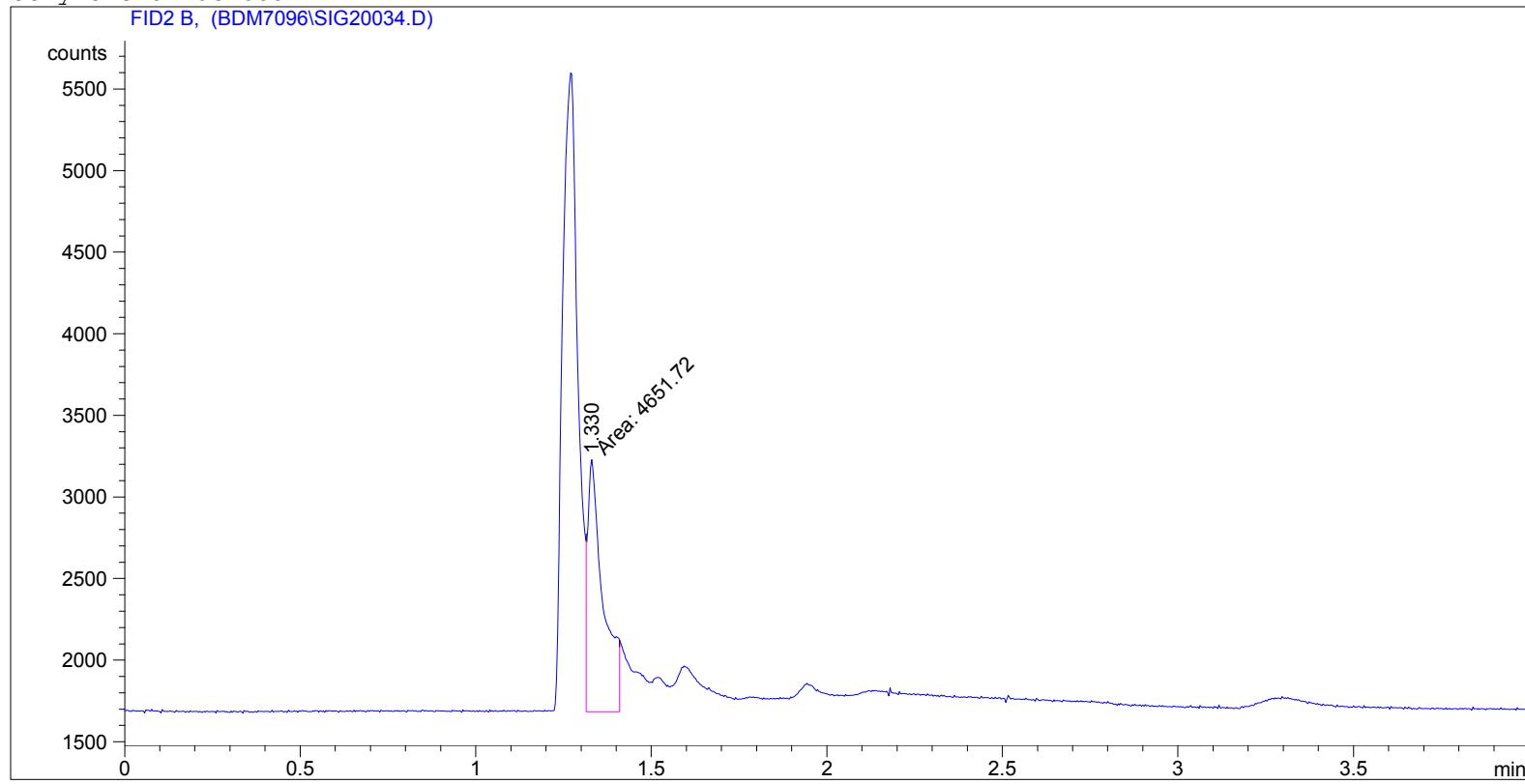
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 5

=====
Injection Date : 7/12/2017 12:17:49 PM
Sample Name : Outlet Run 1 I5 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.330	MF	0.0501	4651.72119	1548.94128	1.000e2

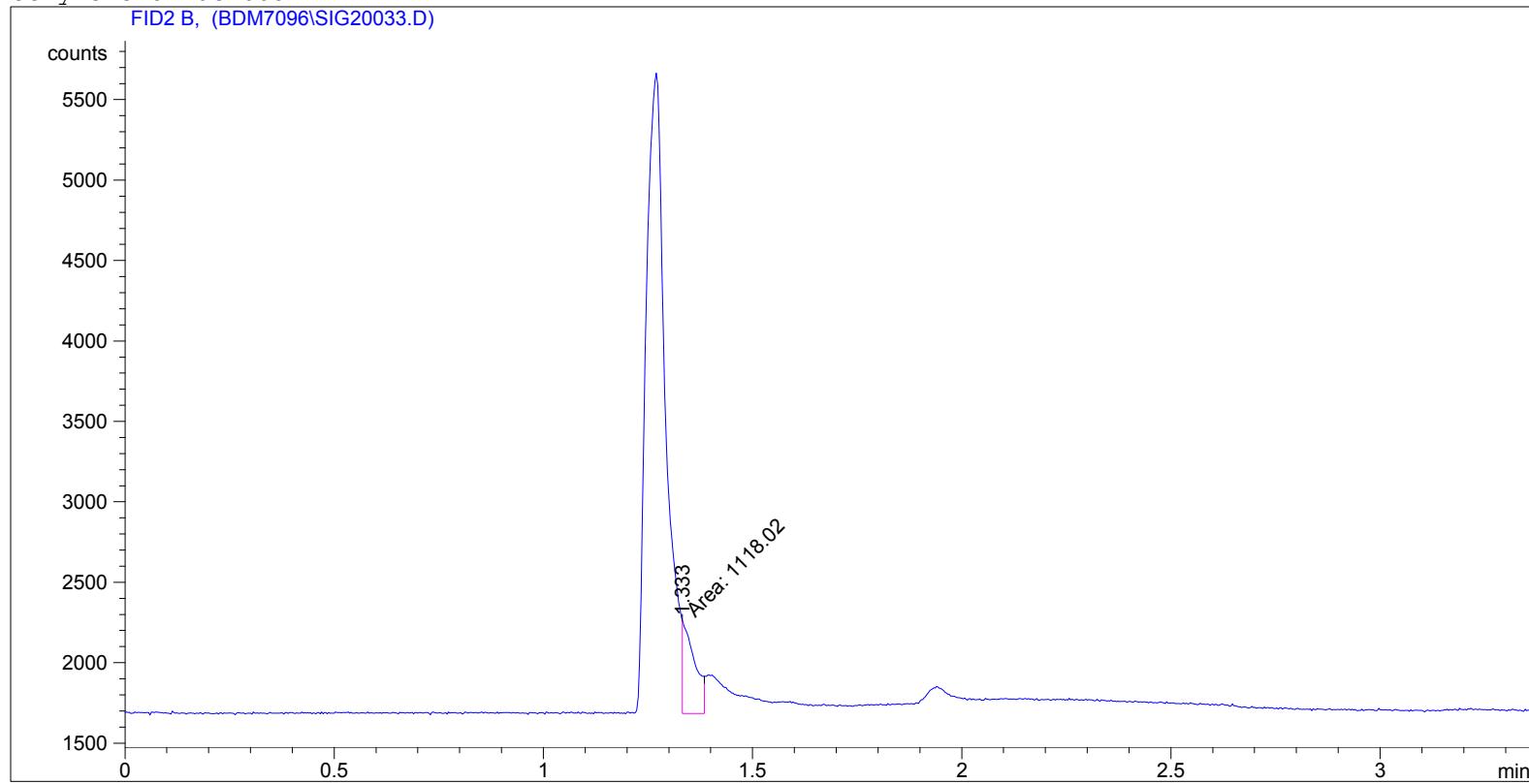
Totals : 4651.72119 1548.94128

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 1 Inj 2

```
=====
Injection Date : 7/12/2017 12:09:01 PM
Sample Name : Outlet Run 1 I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.333	MM	0.0241	1118.01965	574.45953	1.000e2

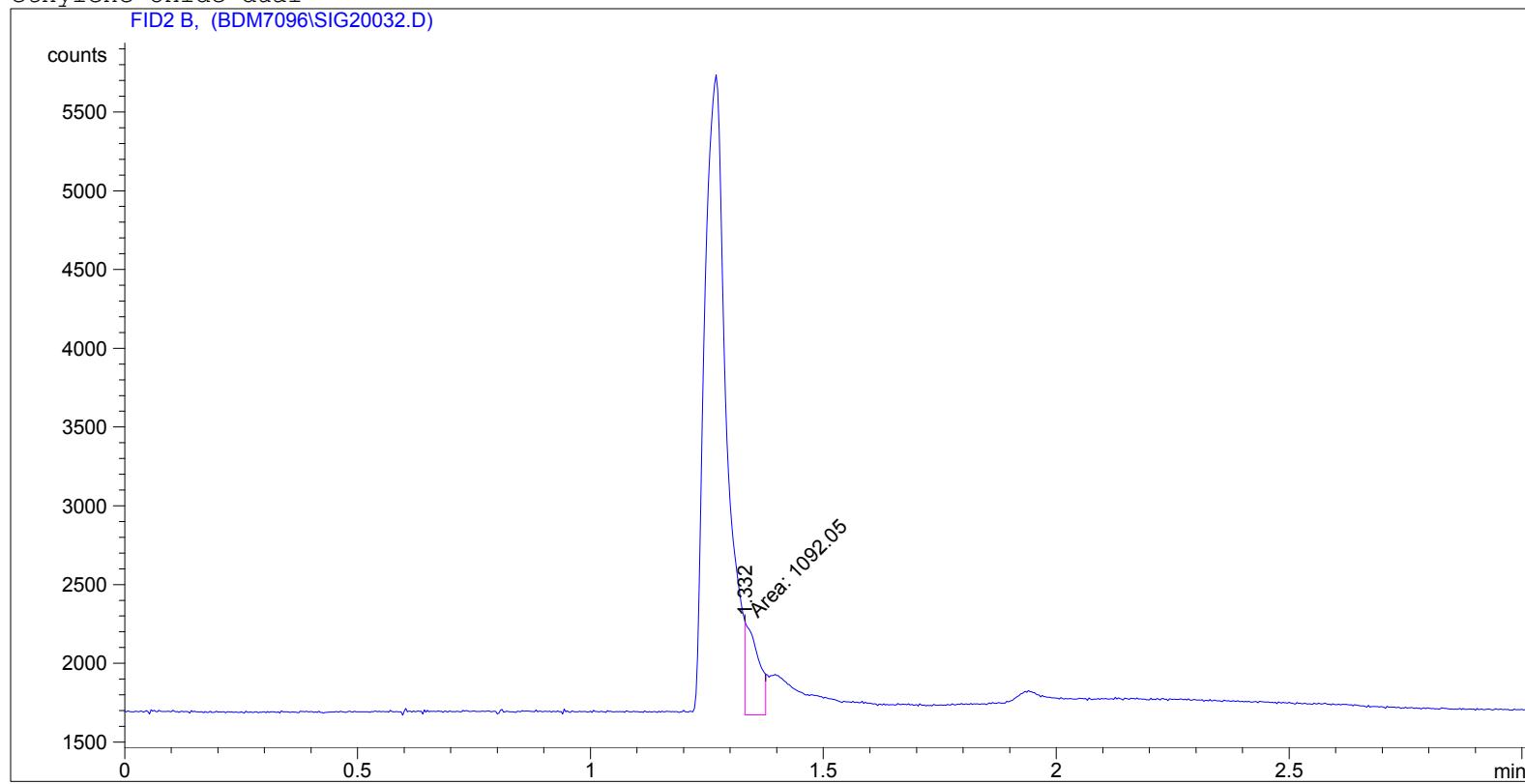
Totals : 1118.01965 574.45953

Results obtained with enhanced integrator!

===== *** End of Report ***

Outlet Run 1 Inj 2

```
=====
Injection Date : 7/12/2017 12:00:07 PM
Sample Name : Outlet Run 1 I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.332	MF	0.0223	1092.04797	592.05560	1.000e2

Totals : 1092.04797 592.05560

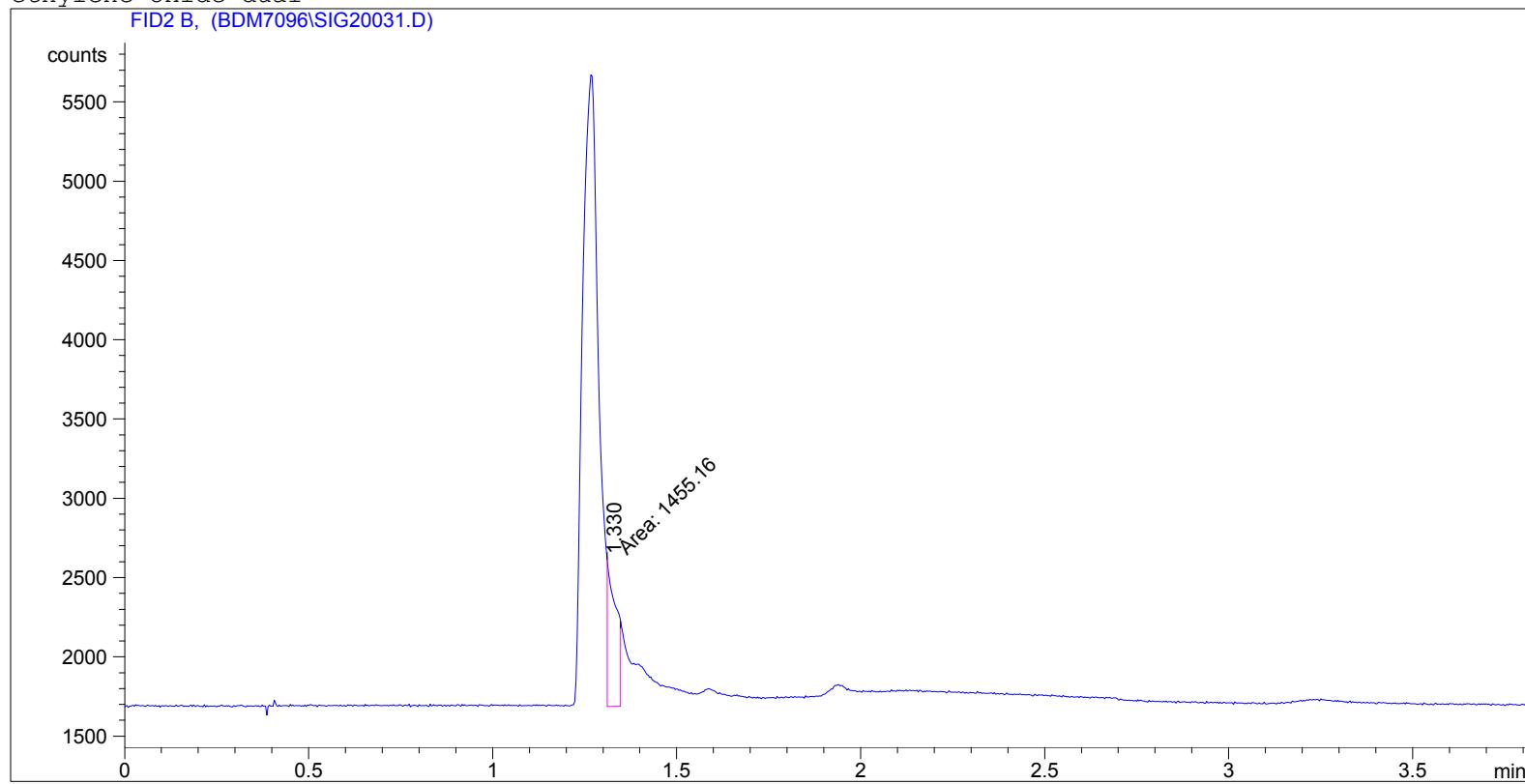
Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 1 Inj 2

=====

Injection Date : 7/12/2017 11:51:09 AM
Sample Name : Outlet Run 1 I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.330	MF	0.0247	1455.16064	928.38831	1.000e2

Totals : 1455.16064 928.38831

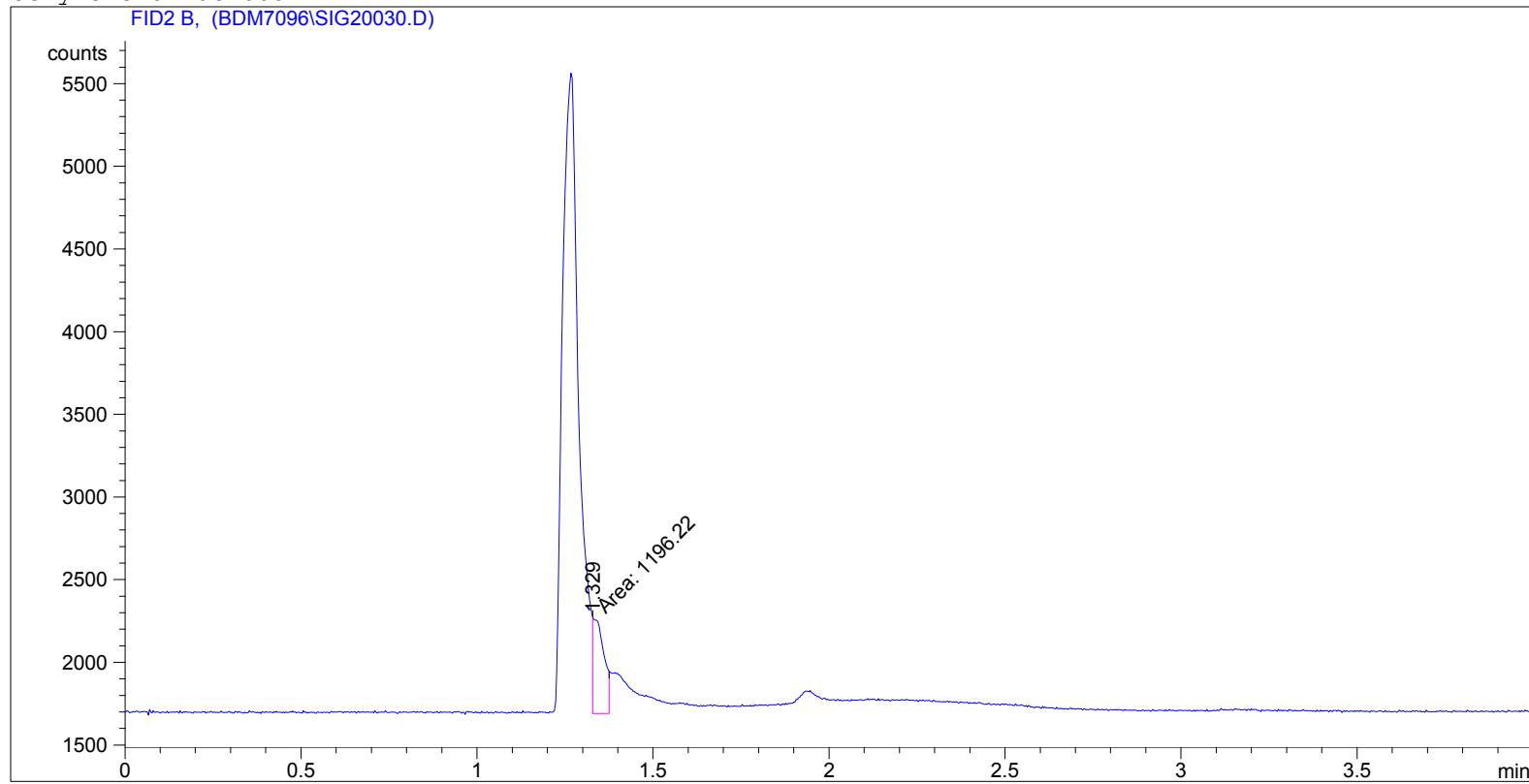
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 1

```
=====
Injection Date : 7/12/2017 11:32:10 AM
Sample Name : Outlet Run 1 II
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.329	FM	0.0345	1196.22339	577.09912	1.000e2

Totals : 1196.22339 577.09912

Results obtained with enhanced integrator!

=====

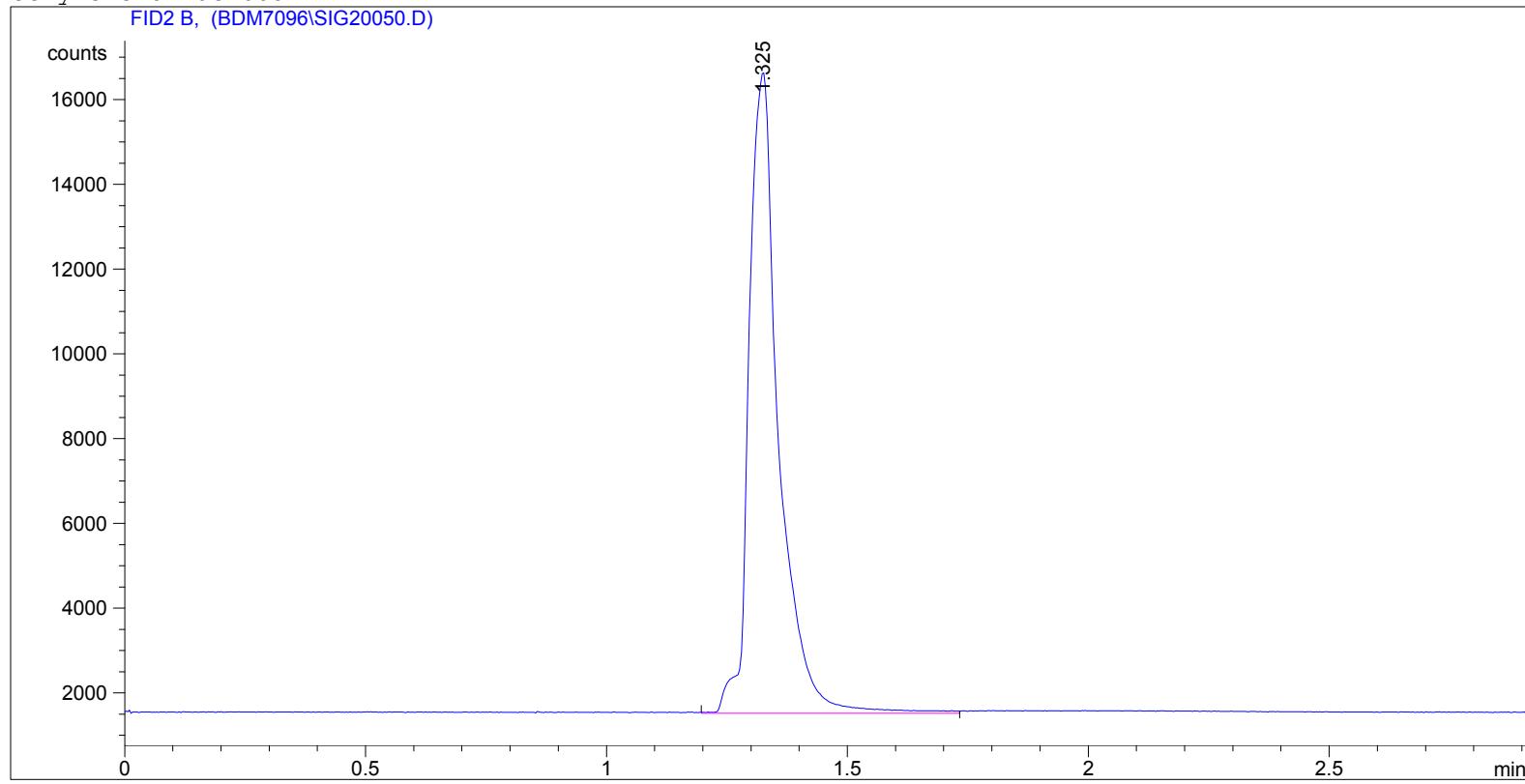
*** End of Report ***

Outlet Post-Cal

Outlet Mid-Level Post Cal Inj 2 25 ppm EO

=====

Injection Date : 7/12/2017 3:47:00 PM
Sample Name : Post Mid Cal I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.325	BV	0.0652	6.50879e4	1.51158e4	1.000e2

Totals : 6.50879e4 1.51158e4

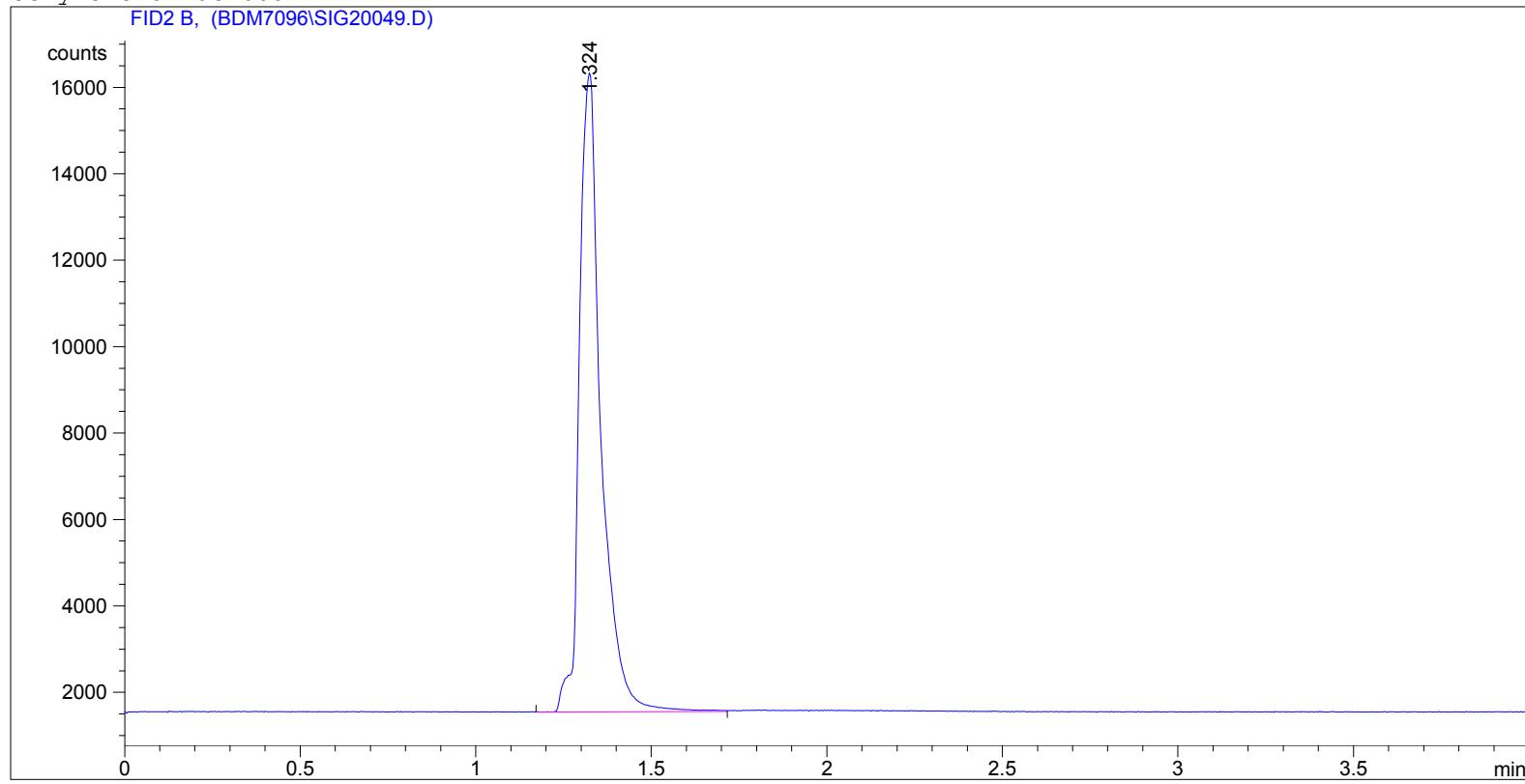
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Mid-Level Post Cal Inj 2 25 ppm EO

```
=====
Injection Date : 7/12/2017 3:39:40 PM
Sample Name : Post Mid Cal I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.324	VV	0.0640	6.33633e4	1.47876e4	1.000e2

Totals : 6.33633e4 1.47876e4

Results obtained with enhanced integrator!

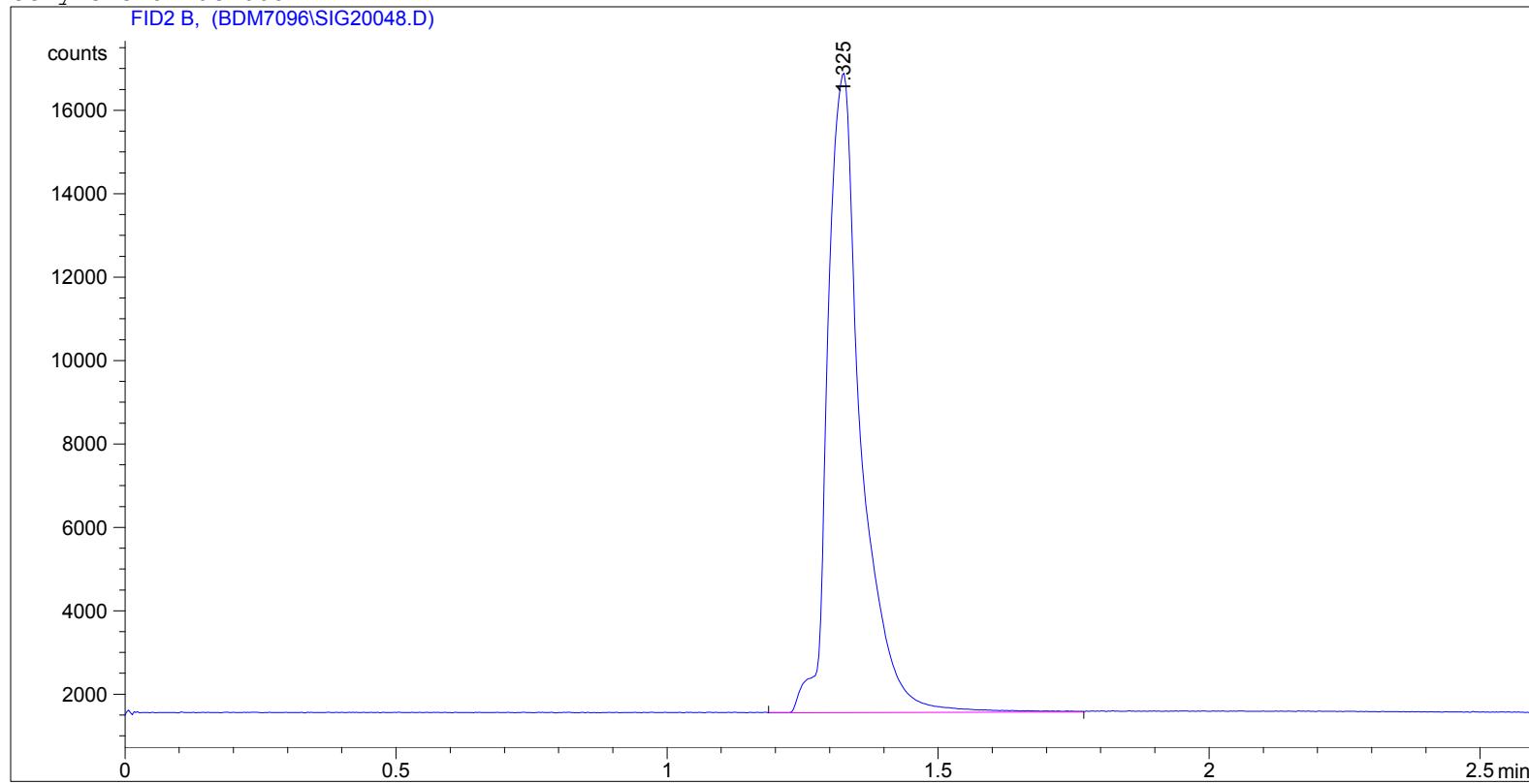
=====

*** End of Report ***

Outlet Mid-Level Post Cal Inj 1 25 ppm EO

=====

Injection Date : 7/12/2017 3:30:57 PM
Sample Name : Post Mid Cal II Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.325	VV	0.0649	6.56793e4	1.53678e4	1.000e2

Totals : 6.56793e4 1.53678e4

Results obtained with enhanced integrator!

=====

*** End of Report ***



Appendix Three: Calibration Information



Wind Tunnel Pitot Calibration

S-type Pitot ID: **P-497** Date: **26-May-16**
Standard Pitot ID: **001** Personnel: **DH**
Cp(std): **0.99** Cp(actual): **0.821**
Part Number: **PPS12-Y-007.5** P_{bar}(in Hg): **29.75**
Test Velocity (fps): **50** T(°F): **80**

A-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.546	0.800	0.818	-0.001
	0.546	0.803	0.816	-0.003
	0.549	0.797	0.821	0.002
	0.551	0.802	0.821	0.001
	AVERAGE		0.819	0.002
			Std deviation	0.002

B-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.549	0.802	0.819	-0.004
	0.549	0.792	0.824	0.002
	0.549	0.793	0.823	0.001
	0.549	0.796	0.823	0.000
	AVERAGE		0.822	0.002
			Std deviation	0.002

$$Cp(s) = Cp(std) \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$Cp(A) - Cp(B) = \boxed{0.003} \quad \{ \text{must be } < 0.010 \}$$

*Deviation = {Cp(s) - AVG Cp(s)} {must be <0.010}

Standard deviation of the deviations must be less than 0.02 for both sides.

**Pitot tube S/N P-497 was calibrated in accordance with the CFR 40, Part 60
Appendix A, Method 2, Section 10.**

Signature
Date



METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

- 1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum volume of 10 cubic feet Vcr (STD). K' factors of ~.8025 = 13 minutes, .5011 = 20 minutes, .3433 = 30 minutes
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

		INITIAL			FINAL			AVG (P _{bar})							
		BAROMETRIC PRESSURE (mbar):			843	BAROMETRIC PRESSURE (in Hg):	24.89379			24.8643	24.879				
		TECHNICIAN/OPERATOR:			Phil Brock										
ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT ³)	AMBIENT	DGM INLET	DGM OUTLET	DGM TIME (MIN) Θ	DGM ΔH (in H ₂ O)	(1) V _m (STD)	(2) V _{cr} (STD)	(3) Y	Y % Diff to Average Y	Y % Diff with other orifices	ΔH _Θ
ORIFICE #	RUN #	INITIAL	FINAL	NET (V _m)	INITIAL	FINAL	INITIAL FINAL	Avg							
63	1	0.5849	17	835.002	847.302	12.30	80.4 78 80 77 78	78.25	16.0	1.35	10.0747	10.0185	0.994	1.59	
	2	0.5849	17	847.302	859.597	12.295	80.6 80 82 78 80	80	16.0	1.35	10.0380	10.0166	0.998	1.58	
	3	0.5849	17	859.597	871.922	12.325	81.1 82 82 80 80	81	16.0	1.35	10.0438	10.0120	0.997	1.58	
48	1	0.3433	19.5	872.002	882.698	10.696	81.9 81 82 80 81	81	24.0	0.46	8.6935	8.8081	1.013	1.56	
	2	0.3433	19.5	882.698	893.387	10.689	82.8 82 82 81 82	81.75	24.0	0.46	8.6758	8.8008	1.014	1.56	
	3	0.3433	19.5	893.387	904.090	10.703	83.1 82 82 82 82	82	24.0	0.46	8.6831	8.7984	1.013	1.56	
73	1	0.8025	14.5	906.001	916.735	10.734	83.1 82 82 82 82	82	10.0	2.65	8.7646	8.5696	0.978	1.66	
	2	0.8025	14.5	916.735	927.50	10.765	82.1 82 81 82 81	81.5	10.0	2.65	8.7980	8.5775	0.975	1.66	
	3	0.8025	14.5	927.50	938.212	10.712	81.1 81 83 81 80	81.25	10.0	2.65	8.7587	8.5855	0.980	1.65	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.996

$$(1) \quad Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions

K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$(2) \quad Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

$$(3) \quad Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

AVERAGE ΔH_Θ = 1.60

$$\Delta H_{\Theta} = \left(\frac{0.75 \Theta}{V_{cr}(std)} \right)^2 \Delta H \left(\frac{V_m(std)}{V_m} \right)$$

Pyrometer Calibration Data

Calibration Temp. Reading (F)	Pyrometer Reading (F)	ABS (Relative Difference) % R
0	0	0.0
50	49	0.2
100	98	0.4
150	149	0.2
250	251	0.1
500	499	0.1
800	802	0.2
Max Absolute Difference %.....		0.4

Omega Temp Calibrator ID 1
Omega Temp Calibrator S/N. T-197197
Calibration Date..... 7/7/2015
Recert Date..... 7/7/2016



METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

- 1) Select a critical orifice to post test calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum volume of 10 cubic feet V_{cr} (STD). K' factors of ~.8025 = 13 minutes, .5011 = 20 min
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 7/14/2017
METER PART #: NA

DGM SERIAL NUMBER: 16095861
CRITICAL ORIFICE MFG: Apex
METHOD 5 BOX ID: M5-13

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (mbar):	843	843	843

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (in Hg):	24.89379	24.8938	24.89379

TECHNICIAN/OPERATOR: Phil Brock

ORIFICE #	RUN #	K'	TESTED	DGM READINGS (FT ³)			TEMPERATURES °F				ELAPSED TIME (MIN)	ΔH (in H ₂ O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	$\Delta H_{@}$		
		FACTOR (AVG)	VACUUM (in Hg)	INITIAL	FINAL	NET (V_m)	AMBIENT	DGM INLET	DGM OUTLET	DGM AVG								
63	1	0.5849	17.5	57.0	73.065	16.065	80	76	79	76	78	77.25	21.00	1.35	13.1909	13.1619	0.998	1.59
	2	0.5849	17.5	73.065	85.293	12.228	80	79	80	78	79	79	16.00	1.35	10.0077	10.0281	1.002	1.58
	3	0.5849	17.5	85.293	100.610	15.317	80	80	80	79	80	79.75	20.00	1.35	12.5184	12.5352	1.001	1.58
															AVG =	1.000		

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.000

$$(1) \quad V_{m_{(std)}} = K_1 * V_m * \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
 $K_1 = 17.64 \text{ }^{\circ}\text{R/in. Hg (English), } 0.3858 \text{ }^{\circ}\text{K/mm Hg (Metric)}$

T_m = Absolute DGM avg. temperature ($^{\circ}\text{R}$ - English, $^{\circ}\text{K}$ - Metric)

$$(2) \quad V_{cr_{(std)}} = K * \frac{P_{bar} * \Theta}{\sqrt{T_{amb}}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature ($^{\circ}\text{R}$ - English, $^{\circ}\text{K}$ - Metric)

K' = Average K' factor from Critical Orifice Calibration

$$(3) \quad Y = \frac{V_{cr_{(std)}}}{V_{m_{(std)}}}$$

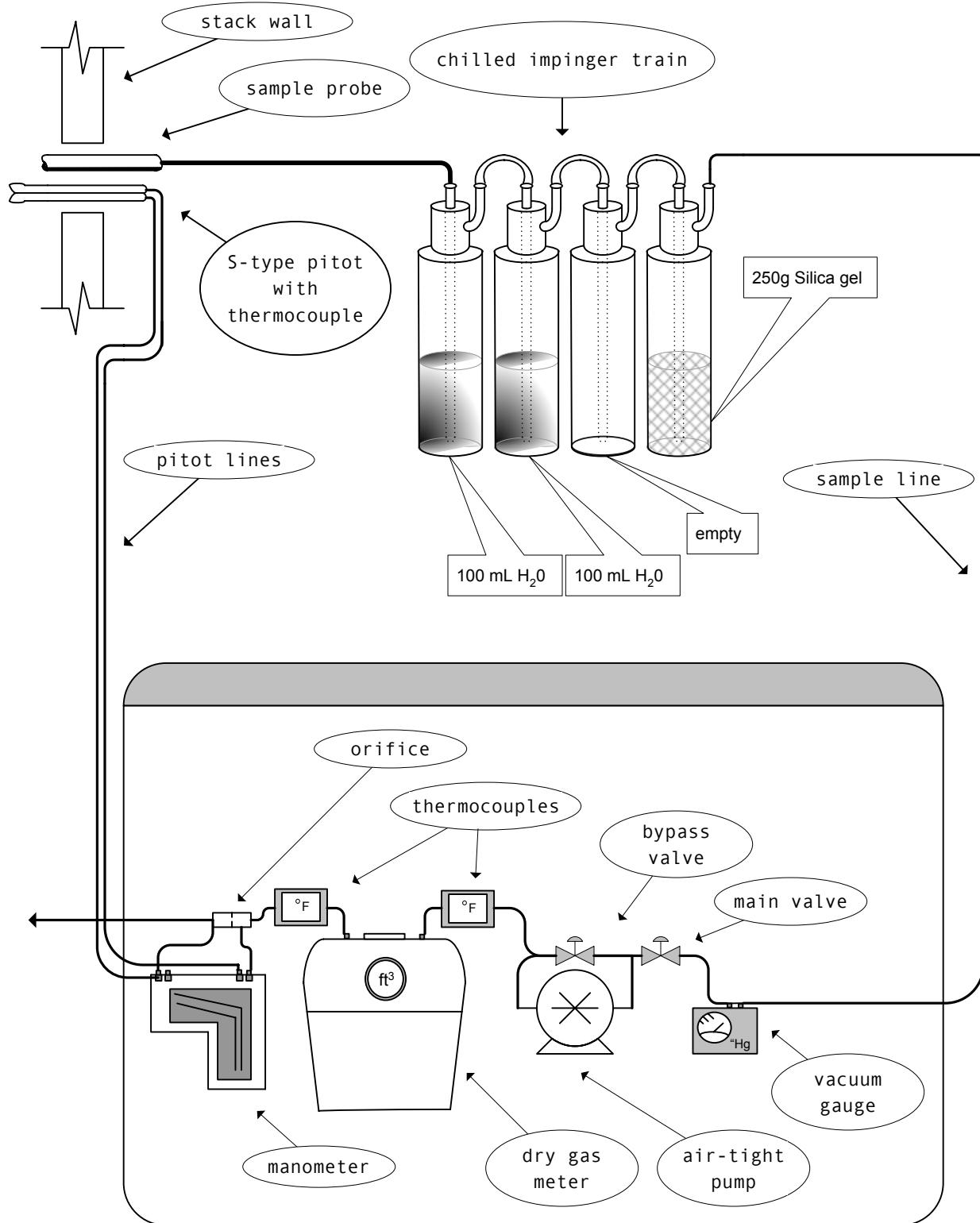
= DGM calibration factor

AVERAGE $\Delta H_{@}$ = 1.58

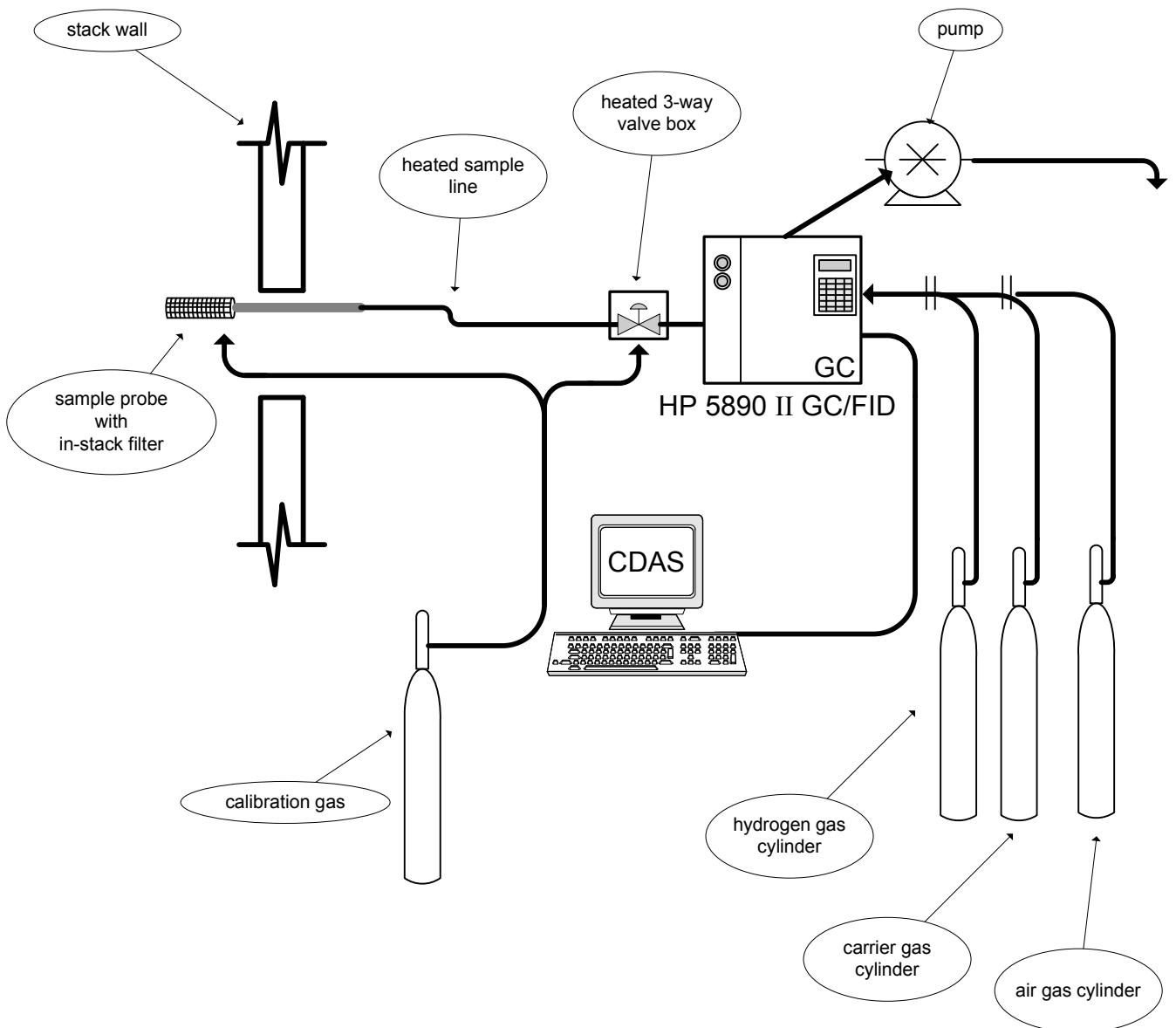
$$\Delta H_{@} = \left(\frac{0.75 \Theta}{V_{cr_{(std)}}} \right)^2 \Delta H \left(\frac{V_{m_{(std)}}}{V_m} \right)$$



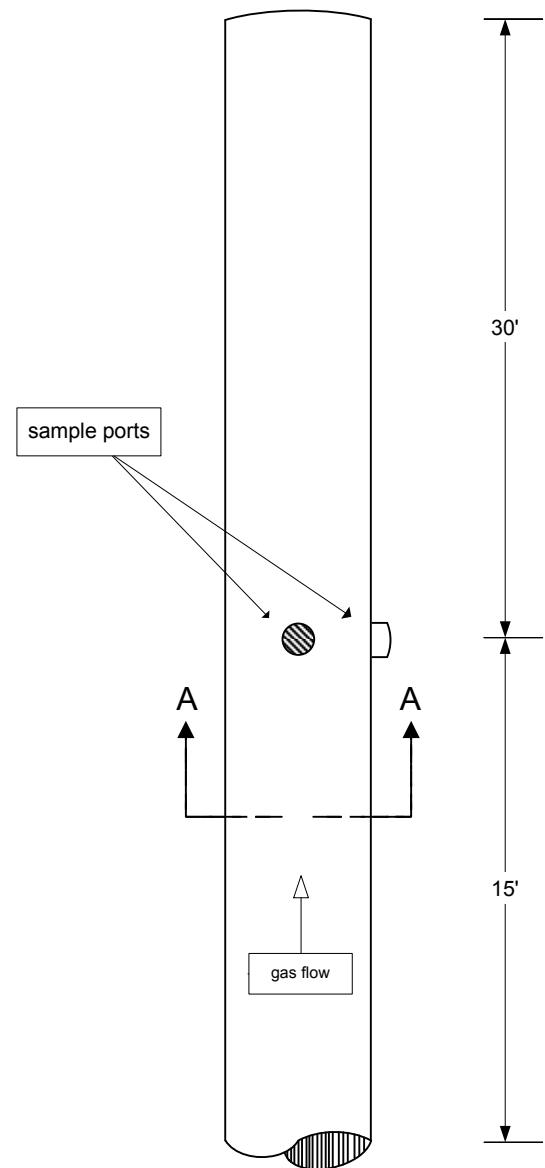
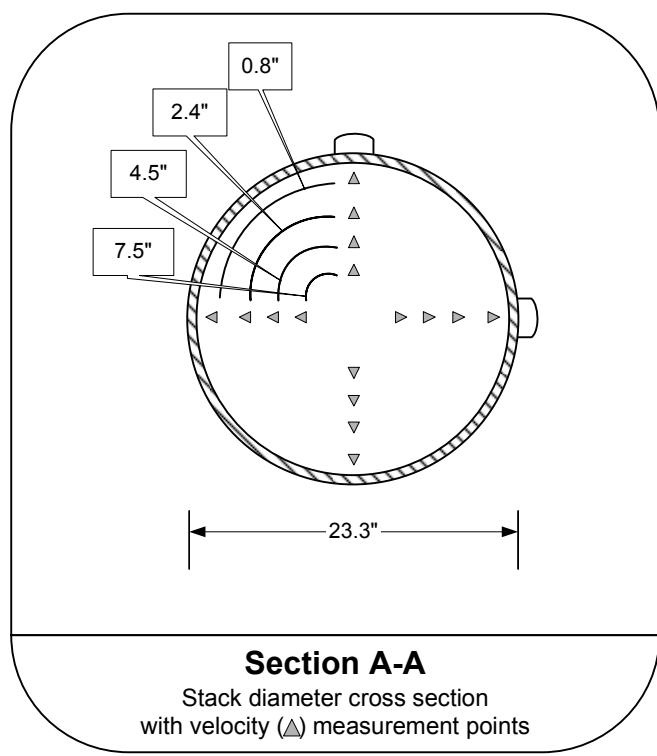
Appendix Four: Schematics



EPA Methods 1,2, & 4
sampling train schematic



EPA Method 18
sampling train schematic



BD Medical - Columbus, Nebraska
 Ethylene Oxide Sterilization Chamber - Catalytic Oxidizer (Outlet)
 Stack Sampling Location Schematic
 (not to scale)



Appendix Five: Operating Data

Lesni Stack Test Data

Date: 12JUL17 Recorded By: Anthony Jasper

Time	% LEL 30.630	% LEL 30.633	Inlet Bed Temp °C (Control) 25.610	Outlet Bed Temp °C 25.611
930 AM	0	0	161	160
940 AM	0	0	161	160
950 AM	1.4	1.3	161	161
1000 AM	1.2	1.3	159	161
1010 AM	2.6	2.5	160	167
1020 AM	3.1	3	160	165
1030 AM	2.9	2.8	160	175
1040 AM	2.9	2.8	160	181
1050 AM	3.2	3.1	159	183
1100 AM	3	3	159	183
1110 AM	2.9	3	161	182
1120 AM	3	3.1	161	185
1130 AM	2.8	2.8	161	184
1140 AM	2.7	2.9	161	185
1150 AM	4.5	4.6	161	185
1200 PM	3.4	3.5	160	187
1210 PM	4.2	4.3	159	187
1220 PM	4.9	5.1	161	193
1230 PM	5	5.1	159	195
1240 PM	6.2	6.8	161	199
1250 PM	5.3	5.6	161	200
100 PM	4.4	4.7	165	207
110 PM	4.6	4.8	165	207
120 PM	4.1	4.2	167	208
130 PM	6	6.1	167	207
140 PM	6	6.1	168	210
150 PM	5.1	5.2	170	211
200 PM	3.3	3.3	170	211
210 PM	4.4	4.5	171	214
220 PM	5.3	5.2	173	217
230 PM	4.8	4.8	173	216
240 PM	4.9	5.1	173	215
250 PM	4.5	4.6	173	212
300 PM	4.2	4.2	171	211
310 PM	3.7	3.6	171	212
320 PM	3.6	3.6	171	211
330 PM	3.4	3.3	170	211
340 PM	4.5	4.7	170	211
350 PM	4.4	4.5	170	210
400 PM	3.3	3.4	169	207
410 PM	3.8	3.9	168	206
420 PM	4.2	4.4	166	205
430 PM	3.5	3.5	165	203
440 PM	3.3	3.2	164	201
450 PM	3.1	3.2	163	199
500 PM	3.4	3.3	161	198
510 PM	3.2	2.9	159	196
520 PM	2.9	2.8	160	192
530 PM	3	2.9	159	190
540 PM	3.6	3.1	159	190
550 PM	3.1	3	159	189
600 PM	2.8	2.8	160	189